Acoustic Characterization of Environments (ACE) Challenge Results Technical Report

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Abstract

This document provides supplementary information, and the results of the tests of acoustic parameter estimation algorithms on the Acoustic Characterization of Environments (ACE) Challenge [1] Evaluation dataset which were subsequently submitted and written up into papers for the Proceedings of the ACE Challenge [2]. This document is supporting material for a forthcoming journal paper on the ACE Challenge which will provide further analysis of the results.

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1 Introduction

This document provides supplementary information and the results of the Acoustic Characterization of Environments (ACE) Challenge Phases 1 and 2 for all the tasks, Reverberation Time ($T_{60}$) and Direct-to-Reverberant Ratio (DRR) estimation in both fullband and in frequency bands.

1.1 Room recording procedure

The recording procedure in each room involved the following steps:

1. Install recording equipment positioning the microphones in Position 1, and document the room dimensions and the positions of all microphones, sources and seats;

2. Make empty-room Acoustic Impulse Response (AIR) measurements and noise recordings; Empty-room measurements were for verification purposes and do not form part of the published corpus since the set is not complete, although they may be used in future experiments;

3. Participating subjects take their seating positions;

4. Make occupied AIR measurements and noise recordings;

5. Move microphones to Position 2 and document their positions;

6. Make occupied AIR measurements and noise recordings;

7. Participants leave the room;

8. Make unoccupied AIR measurements and noise recordings in the second microphone position;

9. Uninstall recording equipment.

1.2 Room properties

1.2.1 Room dimension and microphone positions

Tables 1 and 2 give the room dimensions and positions of the centre of each microphone array. Also included is the position of the source and each of the fans used to create the fan noise. Between 1 and 3 fans were used depending on the size of the room. The microphone elements in the cruciform, mobile, linear array and Chromebook are assumed to be omnidirectional. The look direction is provided for the source and Eigenmike since these do not have an omnidirectional directivity pattern. This look direction also applies to the orientation of the 8-channel linear array which was always perpendicular to the look direction of the Eigenmike. The 3-element mobile array was mounted with the longer edge with two microphones perpendicular to the look direction of the Eigenmike. The individual elements in the Eigenmike are omnidirectional, but are mounted...
on a solid baffle. The look direction is specified in degrees, where 0 degrees is in the direction of \( x = \infty \), and a positive angle is towards \( y = \infty \) as illustrated in Fig. 1. In the ACE Challenge, the Dev dataset used channel 1 of the 8-channel linear array, whilst for the Eval dataset, channel 1 of the 5-channel cruciform was used. Channel 1 of the 5-channel cruciform was the central microphone which is the same position as for the 5-channel array. Therefore, the position of channel 1 of the 8-channel linear array is provided. Where orientation was possible, fans faced in the same look direction as the source.

1.2.2 Talker positions for babble noise

Table 3 provides each of the talker positions used to produce the babble noise. The \( z \) coordinates are not provided since these were not captured. However, the talkers were seated and their mouths were situated at approximately the same height as the microphone arrays which were all at 1.19 m
Table 1: Room dimensions, source, microphone and fan positions

| Room Name         | Mic. Pos. | Dimensions (L, W, H) | Source Position (L, W, H) | Look dir. | 5-channel Cruciform Position (L, W, H) | 3-channel Mobile Position (L, W, H) | 8-channel Linear array Position (L, W, H) |
|-------------------|-----------|----------------------|---------------------------|-----------|----------------------------------------|---------------------------------------|------------------------------------------|
| Office 1          | 1 (3.32, 4.83, 2.95) | (2.06, 1.04, 1.19) | 90 | (2.66, 2.14, 1.19) | (2.29, 2.15, 1.19) | (1.92, 2.14, 1.19) |
| Office 1          | 2 (3.32, 4.83, 2.95) | (2.06, 1.04, 1.19) | 90 | (2.49, 3.69, 1.19) | (2.15, 3.69, 1.19) | (1.79, 3.67, 1.19) |
| Office 2          | 1 (3.22, 5.1, 2.94) | (1.41, 1.73, 1.19) | 90 | (1.25, 2.81, 1.19) | (1.25, 2.62, 1.19) | (0.84, 2.78, 1.19) |
| Office 2          | 2 (3.22, 5.1, 2.94) | (1.41, 1.73, 1.19) | 90 | (2.25, 4.35, 1.19) | (2.05, 4.16, 1.19) | (1.58, 4.16, 1.19) |
| Meeting Room 1    | 1 (6.61, 5.11, 2.95) | (1.39, 1.26, 1.19) | 0 | (2.74, 0.48, 1.19) | (2.74, 0.82, 1.19) | (2.74, 1.14, 1.19) |
| Meeting Room 1    | 2 (6.61, 5.11, 2.95) | (1.39, 1.26, 1.19) | 0 | (3.96, 0.52, 1.19) | (3.96, 0.83, 1.19) | (3.96, 1.14, 1.19) |
| Meeting Room 2    | 1 (10.3, 9.07, 2.63) | (4.65, 4.07, 1.19) | 180 | (3.439, 1.19) | (3.399, 1.19) | (3.359, 1.19) |
| Meeting Room 2    | 2 (10.3, 9.07, 2.63) | (4.65, 4.07, 1.19) | 180 | (2.439, 1.19) | (2.399, 1.19) | (2.359, 1.19) |
| Lecture Room 1    | 1 (6.93, 9.73, 3) | (3.65, 3.73, 1.19) | 180 | (2.81, 3.84, 1.19) | (2.8, 3.44, 1.19) | (2.89, 3.04, 1.19) |
| Lecture Room 1    | 2 (6.93, 9.73, 3) | (3.65, 3.73, 1.19) | 180 | (1.07, 3.92, 1.19) | (1.07, 3.52, 1.19) | (1.07, 3.12, 1.19) |
| Lecture Room 2    | 1 (13.6, 9.29, 2.94) | (6.03, 3.14, 1.19) | 180 | (5.09, 5.87, 1.19) | (5.09, 5.47, 1.19) | (5.09, 5.07, 1.19) |
| Lecture Room 2    | 2 (13.6, 9.29, 2.94) | (6.03, 3.14, 1.19) | 180 | (3.93, 5.87, 1.19) | (3.93, 5.47, 1.19) | (3.93, 5.07, 1.19) |
| Building Lobby 1  | 1 (4.47, 5.13, 3.18) | (1.98, 0.61, 1.19) | 90 | (2.69, 2.02, 1.19) | (2.33, 2, 1.19) | (1.95, 2.03, 1.19) |
| Building Lobby 2  | 2 (4.47, 5.13, 3.18) | (1.98, 0.61, 1.19) | 90 | (2.62, 3.51, 1.19) | (2.25, 3.49, 1.19) | (1.86, 3.54, 1.19) |

above the floor.

1.2.3 Distances and look directions

Table 4 provides the source-microphone distances and Direction-of-Arrivals (DoAs) in spherical coordinates, whilst Table 5 provides the fan-microphone distances and DoAs in spherical coordinates.

1.3 Taxonomy of algorithms submitted

There were three main classes of algorithms submitted to the ACE Challenge:

1. Analytical with or without Bias Compensation (ABC);
2. Single Feature with Mapping (SFM);
3. Machine Learning with Multiple Features (MLMF).
### Table 2: Room dimensions, source, microphone and fan positions continued

| Room Name | Mic. Pos. | 32-ch. Eigenmike Position | Look dir. | 2-channel Chromebook | Ch 1 of 8-ch. linear | Fan 1 | Fan 2 | Fan 3 |
|-----------|-----------|---------------------------|-----------|----------------------|----------------------|-------|-------|-------|
| Office 1  | 1         | (2.94, 2.15, 1.19)        | -90       | (3.02, 2.15, 0.68)   | (1.68, 2.14, 1.19)   | (0.56, 1.43, 1.19) |
| Office 1  | 2         | (2.92, 3.69, 1.19)        | -90       | (2.97, 3.49, 0.68)   | (1.55, 3.67, 1.19)   | (0.56, 1.43, 1.19) |
| Office 2  | 1         | (2.69, 2.84, 1.19)        | -90       | (2.04, 2.84, 0.68)   | (0.6, 2.78, 1.19)    | (2.75, 1.25, 1.19)  |
| Office 2  | 2         | (1.25, 4.25, 1.19)        | -90       | (0.83, 4.13, 0.68)   | (1.34, 4.16, 1.19)   | (2.75, 1.25, 1.19)  |
| Meeting Room 1 | 1 | (2.74, 0.17, 1.19)        | 180       | (2.74, 1.65, 0.68)   | (2.74, 1.38, 1.19)   | (1.62, 2.2, 1.19)   |
| Meeting Room 1 | 2 | (3.96, 0.21, 1.19)        | 180       | (3.96, 1.55, 0.68)   | (3.96, 1.38, 1.19)   | (1.62, 2.2, 1.19)   |
| Meeting Room 2 | 1 | (3, 4.79, 1.19)           | 0         | (3, 5.19, 0.68)      | (3, 3.35, 1.19)      | (3.6, 3.15, 0.35)   | (3.9, 3.25, 0.35) |
| Meeting Room 2 | 2 | (2, 4.79, 1.19)           | 0         | (2, 5.19, 0.68)      | (2, 3.35, 1.19)      | (3.6, 3.15, 0.35)   | (3.9, 3.25, 0.35) |
| Lecture Room 1 | 1 | (2.79, 4.24, 1.19)        | 0         | (2.83, 4.64, 0.68)   | (2.89, 2.8, 1.19)    | (3.65, 3.98, 0.35)  | (3.65, 3.48, 0.35) |
| Lecture Room 1 | 2 | (1.16, 4.32, 1.19)        | 0         | (1.16, 4.72, 0.68)   | (1.07, 2.88, 1.19)   | (3.65, 3.98, 0.35)  | (3.65, 3.48, 0.35) |
| Lecture Room 2 | 1 | (5.09, 6.27, 1.19)        | 0         | (5.09, 6.67, 0.68)   | (5.09, 4.83, 1.19)   | (6.1, 2.82, 0.35)   | (6.1, 3.43, 0.35) |
| Lecture Room 2 | 2 | (3.93, 6.27, 1.19)        | 0         | (3.93, 6.67, 0.68)   | (3.93, 4.83, 1.19)   | (6.1, 2.82, 0.35)   | (6.1, 3.43, 0.35) |
| Building Lobby | 1 | (3.1, 2.04, 1.19)         | -90       | (2.1, 3.49, 0.72)    | (1.71, 2.03, 1.19)   | (1.74, 0.68, 0.35)  |
| Building Lobby | 2 | (2.95, 3.49, 1.19)        | -90       | (3.35, 3.41, 0.72)   | (1.62, 3.54, 1.19)   | (1.74, 0.68, 0.35)  |

### Table 3: Talker positions used to produce babble noise

| Room Name     | Talker ID and associated x-y coordinates |
|---------------|------------------------------------------|
|               | 1         | 2         | 3         | 4         | 5         | 6         | 7         |
| Office 1      | F6:(2.95, 0.85) | M10:(2.37, 0.65) | M11:(1.64, 0.68) | M17:(1.25, 1.18) |
| Office 2      | F7:(0.84, 0.55) | M16:(0.6, 1.39) | M10:(0.55, 2.15) | M12:(2.12, 0.4)   | M20:(2.07, 1.25) | M15:(2.48, 1.9) |
| Meeting Room 1 | F7:(0.4, 0.95) | F8:(1.15, 0.4) | M10:(0.65, 3.25) | M11:(0.55, 0.3)   | M12:(0.37, 1.78) | M23:(0.37, 2.7) |
| Meeting Room 2 | F8:(5.8, 4.53) | M10:(4.39, 2.89) | M11:(5.45, 5.32) | M12:(5.45, 2.95) | M13:(4.98, 5.68) | M14:(4.37, 5.96) | M23:(5.65, 3.73) |
| Lecture Room 1 | F6:(4.75, 3.55) | M11:(4.65, 3.25) | M13:(3.65, 5.08) | M14:(4.45, 2.75) | M18:(4.65, 3.9) | M19:(4.55, 4.38) |
| Lecture Room 2 | F6:(7.2, 2.75) | M10:(6.27, 4.36) | M11:(6.65, 2.12) | M12:(7.07, 3.49) | M13:(6.11, 1.77) | M14:(5.68, 4.52) | M23:(6.82, 4.01) |
| Building Lobby | M10:(1.23, 0.53) | M13:(2.72, 0.53) | M14:(2.23, 0.53) | M21:(0.93, 0.53) | M22:(3.21, 0.53) | |

The ABC approaches derive the estimate for the acoustic parameter directly from the signal without requiring any prior information. Bias compensation may be performed in order to account for noise or specific aspects of the source material. An example of this is the maximum likelihood...
Table 4: Source–microphone distances and DoAs in spherical coordinates

| Name            | Pos.  | Fan | Crnr. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. |
|-----------------|-------|-----|-------|-------|---------|-----|---------|-------|-------|---------|-----|---------|-------|-------|---------|-----|---------|-------|-------|---------|-----|---------|-------|-------|---------|-----|---------|-------|
| Office 1        | 1     | 0   | 0.847 | 0     | 18.8    | 0   | 1.2     | 42.2  | 0     | 0.898   | 18   | 0       | 1.03  | 30.7  | 0       | 1.22| 30.6    | 0     | 1.33   | 41.8  | 0   | 1.16   | 19.1  | 0   |
| Lecture Room 1  | 2     | 1   | 1.25  | -23.2 | 42.6    | 1.21| 2.69    | 44.6  | 1.22  | 3.14    | 30.6 | 1.2     | 50.7  | 0     | 1.2     | 42.2 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 1  | 1     | 1   | 1.16  | 30.7  | 30.7    | 1.22| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Lecture Room 2  | 2     | 2   | 2.24  | -24.2 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.24  | -24.2 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Lecture Room 1  | 2     | 1   | 1.24  | -20.7 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.12  | -22    | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.12  | -22    | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.12  | -22    | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |

Table 5: Fan–microphone distances and DoAs

| Name            | Pos.  | Fan | Crnr. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. | ρ (m) | Elev (°) | Azi | Elev (°) | NoCh. |
|-----------------|-------|-----|-------|-------|---------|-----|---------|-------|-------|---------|-----|---------|-------|-------|---------|-----|---------|-------|-------|---------|-----|---------|-------|-------|---------|-----|
| Office 1        | 1     | 0   | 0.847 | 0     | 18.8    | 0   | 1.2     | 42.2  | 0     | 0.898   | 18   | 0       | 1.03  | 30.7  | 0       | 1.22| 30.6    | 0     | 1.33   | 41.8  | 0   | 1.16   | 19.1  | 0   |
| Lecture Room 1  | 2     | 1   | 1.25  | -23.2 | 42.6    | 1.21| 2.69    | 44.6  | 1.22  | 3.14    | 30.6 | 1.2     | 50.7  | 0     | 1.2     | 42.2 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 1  | 1     | 1   | 1.16  | 30.7  | 30.7    | 1.22| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Lecture Room 2  | 2     | 2   | 2.24  | -24.2 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.24  | -24.2 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.24  | -24.2 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.24  | -24.2 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |
| Meeting Room 2  | 1     | 2   | 2.24  | -24.2 | 30.7    | 1.21| 2.56    | 30.7  | 1.21  | 2.21    | 30.7 | 1.22  | 7.5   | 0     | 1.2     | 30.7 | 0     | 1.33   | 41.8 | 0     | 1.16   | 19.1  | 0   |

method [6] which directly produces the $T_{60}$ estimate. The SFM approaches estimate a parameter from a signal that is correlated with the acoustic parameter to be estimated, and then apply a mapping function to give the acoustic parameter estimate. An example of this is the Spectral Decay Distributions (SDD) method which determines Negative-
Table 6: ACE Challenge participants

| Participant                                      | Algorithms submitted (see results tables) |
|--------------------------------------------------|-------------------------------------------|
| Federal University of Rio de Janeiro             | α                                         |
| Friedrich-Alexander-Universität (FAU)             | B, C, D, E                                |
| Imperial College London                          | F, G                                      |
| Fraunhofer IDMT                                   | H, I, J, K, L, M, N, O                    |
| MuSAELab                                         | O, P, Q, R, S, T, U, V, W, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 |
| Nuance Communications Inc.                        | X, Y, Z                                   |
| Microsoft Research                                | a, b                                      |
| University of Auckland/NTT                        | f, g, h, i, j                             |
| Australian National University (ANU)              | n                                         |

Side Variance (NSV) from STFT bins and then applies a mapping to obtain the $T_{60}$.

The MLMF approaches typically use many features of the source material to train a neural network which then estimates the acoustic parameter from the features of a test signal. An example of this is the Non-Intrusive Room Acoustics (NIRA) [7] algorithm.

There were no hybrid approaches submitted to the ACE Challenge although several participants applied noise reduction to the source signals before performing parameter estimation.

Algorithms are further classified as being either providing an estimate in Fullband (FB), in frequency bands, or Subbands (SBs).

1.4 Results

The participating institutions in the ACE challenge along with their respective algorithms are listed in Table 6 in order of appearance of their algorithms in the results tables. For the fullband tasks the results are presented as box plots where there is a box shown for each algorithm. Both single and multi-channel algorithms are shown in the same figures and tables. On each box in the box plot, the central notch is the median, the edges of the box are the 25th and 75th percentiles, the whiskers extend to the most extreme data points not considered outliers. Boxes are colour-coded according to algorithm class: ABC: yellow; MLMF: cyan; SFM: green.

Outliers are plotted individually. The algorithms are identified on the box plot by a single character which corresponds to the character in the table after the figure. The results are sorted by the research group which achieved the highest correlation coefficient in the results across all noises and Signal-to-Noise Ratios (SNRs) in fullband. For the $T_{60}$ fullband task, the last three algorithms are those compared in Gaubitch et al. [8] and are included as baselines to enable the progress made in blind $T_{60}$ estimation since 2012 to be assessed. Similarly, for the DRR fullband task, Jeub et
is included as the last algorithm since this was a freely available estimator prior to the ACE Challenge. The correlation coefficient for each algorithm is plotted as a black cross in the same column as the algorithm. The value is provided on the right hand y-axis.

A table of numerical results is also provided following each figure which also provides the legend for the algorithm identifiers, A, B, C, etc. The columns in the table are as follows:

1. Ref., the identifier for each algorithm used on the x-axis of the preceding figure;
2. Algorithm, the name used by the respective ACE Challenge participant to refer to their algorithm;
3. Class, the class of algorithm according to Sec. 1.3;
4. Mic. Config, the microphone configuration of the Evaluation dataset used to test the algorithm. Valid values are Single (1-channel), Chromebook (2-channel), Mobile (3-channel), Crucif (5-channel), Lin8Ch (8-channel), and EM32 (32-channel); Further details of the microphone configurations can be found in [1];
5. Bias, the mean error in the results. Let \( X = [x_0, x_1, \ldots, x_{N-1}] \) equal the set of \( N \) ground truth \( T_{\text{gt}} \) and DRR measurements, and let \( \hat{X} \) equal the set of estimated results defined similarly. Then
   \[
   \text{Bias} = \frac{1}{N} \sum_{n=0}^{N-1} x_n - \hat{x}_n;
   \] (1)
6. MSE, the mean squared error in the estimation results defined as
   \[
   \text{MSE} = \frac{1}{N} \sum_{n=0}^{N-1} (x_n - \hat{x}_n)^2.
   \] (2)
7. \( \rho \), the Pearson correlation coefficient between the estimated and the ground truth results defined as
   \[
   \rho = \frac{E(\hat{X}X) - E(\hat{X})E(X)}{\sqrt{(E(X^2) - E(X)^2)(E(X^2) - E(X)^2))}};
   \] (3)
   where \( E(\cdot) \) is the mathematical expectation;
8. RTF, the real-time factor, the total computation time divided by the total duration of all processed speech files. All implementations were in Matlab except for those marked with a \(^1\) which used Matlab for feature extraction and C++ for the machine learning-based mapping, and those marked with a \(^\dagger\) which were implemented entirely in C++.
By considering the bias, MSE, and $\rho$, it is possible to determine how well the estimator works. For example, an estimator with a low bias and MSE might simply be giving an estimate close to the median for every speech file. However, by examining the $\rho$, it will be possible to distinguish between such an algorithm, which will have a low correlation, and a better algorithm which is more accurately estimating the parameter concerned which will have a higher correlation. The RTF is useful for determining whether the algorithm has practical applications requiring low computational complexity such as hearing aids and mobile devices.

For the frequency-dependent tasks, a box plot is provided per algorithm with each box representing the performance in a particular frequency band. Frequency dependent algorithms have also been included in the fullband plots. Where those algorithms themselves produce a fullband estimate, this has been used directly as in the case of the DRR Estimation using a Null-Steered Beamformer (DENBE) [5] and Particle Velocity [4] algorithms. Where no fullband estimate is produced, a fullband estimate was obtained by taking the mean of the results over the 400 to 1250 Hz frequency bands as in the case of the Model-based subband RTE [3] algorithm as recommended in ISO 3382 [10].
2 Overall results summary

2.1 Fullband $T_{60}$ estimation overall results

The overall results for fullband $T_{60}$ estimation are shown in Fig. 2 and Table 7.

Figure 2: Fullband $T_{60}$ estimation error in all noises for all SNRs
Table 7: $T_{60}$ estimation algorithm performance in all noises for all SNRs

| Ref. | Algorithm                          | Class | Mic. Config. | Bias  | MSE  | $\rho$ | RTF |
|------|------------------------------------|-------|--------------|-------|------|--------|-----|
| A    | QA Reverb [11]                     | SFM   | Single       | -0.068| 0.0648| 0.778  | 0.4 |
| B    | Octave SB-based FB RTE [3]         | ABC   | Single       | -0.104| 0.0731| 0.738  | 0.939 |
| C    | DCT-based FB RTE [3]               | ABC   | Single       | -0.104| 0.0766| 0.71   | 1   |
| D    | Model-based SB RTE [3]             | ABC   | Single       | -0.0196| 0.0981| 0.661  | 0.451 |
| E    | Baseline algorithm for FB RTE [3]  | ABC   | Single       | -0.0432| 0.11  | 0.387  | 0.0424 |
| F    | SDDSA-G retrained [12]             | SFM   | Single       | 0.0167 | 0.0937| 0.608  | 0.0152 |
| G    | SDDSA-G [15]                       | SFM   | Single       | -0.0423| 0.0803| 0.6    | 0.0164 |
| H    | Multi-layer perceptron P2 [14]     | MLMF  | Single       | -0.0967| 0.104 | 0.48   | 0.0578\* |
| I    | Multi-layer perceptron P2 [14]     | MLMF  | Single       | -0.0497| 0.0992| 0.46   | 0.0578\* |
| J    | Multi-layer perceptron P2 [14]     | MLMF  | Chromebook   | -0.054 | 0.0933| 0.525  | 0.0589\* |
| K    | Multi-layer perceptron P2 [14]     | MLMF  | Mobile       | -0.0299| 0.082 | 0.447  | 0.0556\* |
| L    | Multi-layer perceptron P2 [14]     | MLMF  | Crucif       | -0.0503| 0.1   | 0.454  | 0.0569\* |
| M    | Multi-layer perceptron P2 [14]     | MLMF  | Lin8Ch       | -0.0468| 0.0868| 0.443  | 0.0618\* |
| N    | Multi-layer perceptron P2 [14]     | MLMF  | EM32         | -0.0602| 0.0879| 0.43   | 0.0576\* |
| O    | Per acoust. band SRMR Sec. 2.5 [15]| SFM   | Single       | -0.114 | 0.109 | 0.48   | 0.578 |
| P    | NSRMR Sec. 2.4 [16, 15]            | SFM   | Single       | -0.0646| 0.119 | 0.261  | 0.571 |
| Q    | NSRMR Sec. 2.4 [16, 15]            | SFM   | Chromebook   | 0.012  | 0.116 | 0.291  | 1.04  |
| R    | NSRMR Sec. 2.4 [16, 15]            | SFM   | Mobile       | -0.0504| 0.0958| 0.281  | 1.58  |
| S    | NSRMR Sec. 2.4 [16, 15]            | SFM   | Crucif       | -0.0516| 0.107 | 0.246  | 2.62  |
| T    | SRMR Sec. 2.3 [15]                 | SFM   | Single       | -0.16  | 0.144 | 0.22   | 0.457 |
| U    | SRMR Sec. 2.3 [15]                 | SFM   | Chromebook   | -0.105 | 0.132 | 0.221  | 0.829 |
| V    | SRMR Sec. 2.3 [15]                 | SFM   | Mobile       | -0.153 | 0.12  | 0.228  | 1.26  |
| W    | SRMR Sec. 2.3 [15]                 | SFM   | Crucif       | -0.153 | 0.128 | 0.225  | 2.09  |
| X    | NIRAv3 [7]                         | MLMF  | Single       | -0.192 | 0.151 | 0.302  | 0.899\* |
| Y    | NIRAv1 [7]                         | MLMF  | Single       | -0.184 | 0.151 | 0.258  | 0.899\* |
| Z    | NIRAv2 [7]                         | MLMF  | Single       | -0.179 | 0.198 | -0.0199| 0.907\* |
| a    | Blur kernel [17]                   | SFM   | Single       | 0.173  | 0.15  | 0.279  | 8.46  |
| b    | Blur kernel with sliding window [18]| SFM   | Single       | -0.00555| 0.139| 0.12   | 0.421 |
| c    | Temporal dynamics [19]             | SFM   | Single       | -0.304 | 0.211| 0.269  | 0.362 |
| d    | Improved blind RTE [6]             | ABC   | Single       | -0.0635| 0.165| 0.166  | 0.0259 |
| e    | SDD [20]                           | SFM   | Single       | 0.463  | 305  | 0.00158| 0.0221 |
2.2 Fullband DRR estimation overall results

The overall results for fullband DRR estimation are shown in Fig. 3 and Table 8.

Figure 3: Fullband DRR estimation error in all noises for all SNRs
Table 8: DRR estimation algorithm performance in all noises for all SNRs

| Ref. | Algorithm Description | Class | Misc. Config. | Bias | MSE  | $\rho$ | RTF  |
|------|----------------------|-------|---------------|------|------|--------|-------|
| f    | PSD est. in beamspace, bias comp. [21] | ABC   | Mobile        | 1.07 | 8.14 | 0.577  | 0.757 |
| g    | PSD est. in beamspace (Raw) [21] | ABC   | Mobile        | -5.9 | 41.8 | 0.577  | 3.17  |
| h    | PSD est. in beamspace v2 [21] | ABC   | Mobile        | -5.7 | 43   | 0.41   | 0.844 |
| i    | PSD est. by twin BF [22] | ABC   | Mobile        | -5.71| 44.9 | 0.362  | 0.614 |
| j    | Spatial Covariance in matrix mode [23] | ABC   | Mobile        | -5.37| 61.2 | 0.244  | 0.627 |
| k    | NIRAv2 [7] | MLMF  | Single        | -1.85| 14.8 | 0.558  | 0.899 |
| l    | NIRAv3 [7] | MLMF  | Single        | -1.62| 14.7 | 0.515  | 0.899 |
| m    | NIRAv1 [7] | MLMF  | Single        | -1.64| 15   | 0.507  | 0.899 |
| n    | Particle velocity [4] | ABC   | EM32          | -2.38| 10.4 | 0.449  | 0.134 |
| o    | Multi-layer perceptron [14] | MLMF  | Single        | -1.14| 15.9 | 0.405  | 0.0578|
| p    | Multi-layer perceptron P2 [14] | MLMF  | Single        | -1.52| 16.1 | 0.507  | 0.0578|
| q    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook    | -2.43| 13.6 | 0.285  | 0.0589|
| r    | Multi-layer perceptron P2 [14] | MLMF  | Mobile        | -1.67| 15   | 0.403  | 0.0556|
| s    | Multi-layer perceptron P2 [14] | MLMF  | Crucif        | -1.5 | 16   | 0.503  | 0.0569|
| t    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch        | -3.64| 25.7 | 0.314  | 0.0618|
| u    | Multi-layer perceptron P2 [14] | MLMF  | EM32          | -2.22| 14.6 | 0.325  | 0.0576|
| v    | DENBE no noise reduction [24] | ABC   | Chromebook    | -6.04| 51.2 | 0.308  | 0.0323|
| w    | DENBE spectral subtraction [5] | ABC   | Chromebook    | -4.25| 34.1 | 0.314  | 0.0589|
| x    | DENBE spec. sub. Gerkmann [24] | ABC   | Chromebook    | -4.01| 32.8 | 0.303  | 0.0477|
| y    | DENBE filtered subbands [5] | ABC   | Chromebook    | -4.01| 32.8 | 0.303  | 0.775 |
| z    | DENBE FFT derived subbands [5] | ABC   | Chromebook    | -4.01| 32.8 | 0.303  | 0.0449|
| 0    | Normalized Overall SRMR (NOSRMR) Sec. 2.2. [15] | SFM   | Chromebook    | -3.71| 20.6 | 0.259  | 0.829 |
| 1    | Overall SRMR (OSRMR) Sec. 2.2. [15] | SFM   | Chromebook    | -3.71| 20.6 | 0.259  | 0.829 |
| 2    | NOSRMR Sec. 2.2. [15] | SFM   | Mobile        | -4.47| 32   | 0.148  | 1.58  |
| 3    | OSRMR Sec. 2.2. [15] | SFM   | Mobile        | -3.28| 22.2 | 0.116  | 1.26  |
| 4    | NOSRMR Sec. 2.2. [15] | SFM   | Crucif        | -4.05| 31.1 | 0.0814 | 2.62  |
| 5    | OSRMR Sec. 2.2. [15] | SFM   | Crucif        | -2.88| 22.3 | 0.0816 | 2.09  |
| 6    | NOSRMR Sec. 2.2. [15] | SFM   | Single        | -4.16| 33.9 | -0.0814| 0.54  |
| 7    | OSRMR Sec. 2.2. [15] | SFM   | Single        | -4.24| 34.6 | -0.0815| 0.446 |
| 8    | Per acoust. band SRMR Sec. 2.5. [15] | SFM   | Single        | -0.9 | 22.8 | 0.00192| 0.578 |
| 9    | Temporal dynamics [23] | SFM   | Single        | -11.4| 147  | 0.0815 | 0.082 |
| α    | QA Reverb [11] | SFM   | Single        | 2.51 | 23.6 | 0.0576 | 0.391 |
| β    | Blind est. of coherent-to-diffuse energy ratio [9] | ABC   | Chromebook    | -12.1| 162  | 0.305  | 0.019 |

Note: The table entries represent the performance metrics for different algorithms under various conditions and configurations. The columns include the reference number, algorithm description, class, microphone configuration, bias, mean square error (MSE), $\rho$, and relative time factor (RTF).
2.2.1 Fullband $T_{60}$ estimation results by parameter

Figure 4: FB $T_{60}$ estimation error in all noises and all SNRs for a) female talkers and b) male talkers
Figure 5: Single channel FB $T_{60}$ estimation error in all noises and all SNRs for a) $T_{60} < 0.43$ s b) $0.43 \leq T_{60} < 0.75$ s and c) $T_{60} \geq 0.75$ s. Observe that $\rho < 0$ for all except algorithm D.
Figure 6: FB $T_{60}$ estimation error in all noises at a), 18 dB SNR, b), 12 dB SNR, and c) −1 dB SNR
Figure 7: FB $T_{60}$ estimation error in all noises and all SNRs for a) utterance length $< 5$ s b) utterance length $< 15$ s and c) utterance length $\geq 15$ s
2.2.2 Fullband DRR estimation results by parameter

Figure 8: FB DRR estimation error in all noises and all SNRs for a) female talkers and b) male talkers
Figure 9: Single channel FB DRR estimation error in all noises and all SNRs for a) DRR $< 2$ dB b) $2 \leq$ DRR $< 5$ dB and c) DRR $\geq 5$ dB

Figure 10: Mobile (3-channel) FB DRR estimation error in all noises and all SNRs for a) DRR $< 2$ dB b) $2 \leq$ DRR $< 5$ dB and c) DRR $\geq 5$ dB. Note that for b) there are strong negative correlations for all algorithms
Figure 11: FB DRR estimation error in all noises at a) 18 dB SNR, b) 12 dB SNR, and c) −1 dB SNR
Figure 12: FB DRR estimation error in all noises and all SNRs for a) utterance length < 5 s b) utterance length < 15 s and c) utterance length ≥ 15 s
3 $T_{60}$ estimation results

3.1 Fullband $T_{60}$ estimation results by noise type

3.1.1 Ambient noise
Figure 13: Fullband $T_{60}$ estimation error in ambient noise for all SNRs
### Table 9: $T_{60}$ estimation algorithm performance in ambient noise for all SNRs

| Ref. | Algorithm                                | Class   | Mic. Config. | Bias    | MSE   | $\rho$ | RTF  |
|------|------------------------------------------|---------|--------------|---------|-------|--------|------|
| A    | QA Reverb [11]                           | SFM     | Single       | -0.0682 | 0.0565 | 0.833  | 0.401 |
| B    | Octave SB-based FB RTE [3]               | ABC     | Single       | -0.0993 | 0.068  | 0.769  | 1    |
| C    | DCT-based FB RTE [3]                     | ABC     | Single       | -0.0978 | 0.0738 | 0.715  | 1.04 |
| D    | Model-based SB RTE [3]                   | ABC     | Single       | -0.0219 | 0.0891 | 0.716  | 0.478 |
| E    | Baseline algorithm for FB RTE [3]        | ABC     | Single       | -0.0411 | 0.105  | 0.422  | 0.0421 |
| F    | SDDSA-G retrained [12]                   | SFM     | Single       | -0.0817 | 0.0676 | 0.723  | 0.0153 |
| G    | SDDSA-G [13]                             | SFM     | Single       | -0.117  | 0.0738 | 0.729  | 0.0166 |
| H    | Multi-layer perceptron P2 [14]           | MLMF    | Single       | -0.125  | 0.0977 | 0.576  | 0.0578 |
| I    | Multi-layer perceptron P2 [14]           | MLMF    | Single       | -0.0844 | 0.0969 | 0.518  | 0.0578 |
| J    | Multi-layer perceptron P2 [14]           | MLMF    | Chromebook   | -0.0704 | 0.0917 | 0.553  | 0.0589 |
| K    | Multi-layer perceptron P2 [14]           | MLMF    | Mobile       | -0.0581 | 0.0798 | 0.492  | 0.0557 |
| L    | Multi-layer perceptron P2 [14]           | MLMF    | Crucif       | -0.0852 | 0.0971 | 0.518  | 0.0569 |
| M    | Multi-layer perceptron P2 [14]           | MLMF    | Lin8Ch       | -0.0818 | 0.084  | 0.508  | 0.062  |
| N    | Multi-layer perceptron P2 [14]           | MLMF    | EM32         | -0.0968 | 0.084  | 0.519  | 0.0578 |
| O    | Acoust. band SRMR Sec. 2.5. [15]         | SFM     | Single       | -0.16   | 0.113  | 0.572  | 0.58  |
| P    | NSRMR Sec. 2.4. [16, 15]                 | SFM     | Single       | -0.0964 | 0.123  | 0.27   | 0.571 |
| Q    | NSRMR Sec. 2.4. [16, 15]                 | SFM     | Chromebook   | -0.00429| 0.116  | 0.291  | 1.04  |
| R    | NSRMR Sec. 2.4. [16, 15]                 | SFM     | Mobile       | -0.0837 | 0.0976 | 0.306  | 1.59  |
| S    | NSRMR Sec. 2.4. [16, 15]                 | SFM     | Crucif       | -0.0838 | 0.11   | 0.256  | 2.63  |
| T    | SRMR Sec. 2.3. [15]                      | SFM     | Single       | -0.195  | 0.153  | 0.249  | 0.457 |
| U    | SRMR Sec. 2.3. [15]                      | SFM     | Chromebook   | -0.13   | 0.136  | 0.239  | 0.831 |
| V    | SRMR Sec. 2.3. [15]                      | SFM     | Mobile       | -0.189  | 0.129  | 0.268  | 1.26  |
| W    | SRMR Sec. 2.3. [15]                      | SFM     | Crucif       | -0.188  | 0.137  | 0.263  | 2.09  |
| X    | NIRAv3 [7]                               | MLMF    | Single       | -0.263  | 0.172  | 0.406  | 0.897 |
| Y    | NIRAv1 [7]                               | MLMF    | Single       | -0.243  | 0.166  | 0.363  | 0.897 |
| Z    | NIRAv2 [7]                               | MLMF    | Single       | -0.183  | 0.198  | -0.0532| 0.912 |
| a    | Blur kernel [17]                         | SFM     | Single       | 0.164   | 0.15   | 0.274  | 8.16  |
| b    | Blur kernel with sliding window [18]     | SFM     | Single       | -0.0155 | 0.137  | 0.144  | 0.413 |
| c    | Temporal dynamics [19]                   | SFM     | Single       | -0.359  | 0.239  | 0.319  | 0.362 |
| d    | Improved blind RTE [6]                   | ABC     | Single       | -0.0752 | 0.168  | 0.159  | 0.0255 |
| e    | SDD [20]                                 | SFM     | Single       | -0.515  | 0.355  | 0.524  | 0.0219 |
3.1.2 Babble noise

Figure 14: Fullband $T_{60}$ estimation error in babble noise for all SNRs
| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE  | $\rho$ | RTF |
|------|-----------|-------|-------------|------|------|-------|-----|
| A    | QA Reverb [11] | SFM   | Single      | -0.109 | 0.0707 | 0.805 | 0.398 |
| B    | Octave SB-based FB RTE [3] | ABC   | Single      | -0.124 | 0.0701 | 0.809 | 0.911 |
| C    | DCT-based FB RTE [3] | ABC   | Single      | -0.106 | 0.0718 | 0.755 | 0.99  |
| D    | Model-based SB RTE [3] | ABC   | Single      | -0.0573 | 0.0877 | 0.743 | 0.443 |
| E    | Baseline algorithm for FB RTE [3] | ABC   | Single      | -0.0236 | 0.112  | 0.36  | 0.0428 |
| F    | SDDSA-G retrained [12] | SFM   | Single      | 0.0688  | 0.0836 | 0.673 | 0.0155 |
| G    | SDDSA-G [13] | SFM   | Single      | -0.000784 | 0.0718 | 0.649 | 0.0162 |
| H    | Multi-layer perceptron [14] | MLMF  | Single      | -0.0684 | 0.106  | 0.419 | 0.0579³ |
| I    | Multi-layer perceptron P2 [14] | MLMF  | Single      | -0.045  | 0.092  | 0.52  | 0.0579³ |
| J    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook  | -0.0534 | 0.0912 | 0.543 | 0.0588³ |
| K    | Multi-layer perceptron P2 [14] | MLMF  | Mobile      | -0.0244 | 0.0796 | 0.465 | 0.0555⁵ |
| L    | Multi-layer perceptron P2 [14] | MLMF  | Crucif      | -0.0432 | 0.0948 | 0.494 | 0.057⁴ |
| M    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch      | -0.0277 | 0.084  | 0.452 | 0.0618⁴ |
| N    | Multi-layer perceptron P2 [14] | MLMF  | EM32        | -0.0569 | 0.0853 | 0.451 | 0.0576⁴ |
| O    | Per acoust. band SRMR Sec. 2.5 [15] | SFM   | Single      | -0.0967 | 0.0992 | 0.593 | 0.579 |
| P    | NSRMR Sec. 2.4. [16, 15] | SFM   | Single      | -0.0435 | 0.11   | 0.347 | 0.572 |
| Q    | NSRMR Sec. 2.4. [16, 15] | SFM   | Chromebook  | 0.00512 | 0.11   | 0.353 | 1.04  |
| R    | NSRMR Sec. 2.4. [16, 15] | SFM   | Mobile      | -0.0287 | 0.0873 | 0.364 | 1.58  |
| S    | NSRMR Sec. 2.4. [16, 15] | SFM   | Crucif      | -0.03   | 0.098  | 0.335 | 2.63  |
| T    | SRMR Sec. 2.3. [15] | SFM   | Single      | -0.129  | 0.133  | 0.246 | 0.457 |
| U    | SRMR Sec. 2.3. [15] | SFM   | Chromebook  | -0.0928 | 0.13   | 0.217 | 0.833 |
| V    | SRMR Sec. 2.3. [15] | SFM   | Mobile      | -0.12   | 0.109  | 0.257 | 1.26  |
| W    | SRMR Sec. 2.3. [15] | SFM   | Crucif      | -0.121  | 0.118  | 0.252 | 2.1   |
| X    | NIRAv3 [7] | MLMF  | Single      | -0.0965 | 0.121  | 0.35  | 0.906⁴ |
| Y    | NIRAv1 [7] | MLMF  | Single      | -0.0899 | 0.124  | 0.292 | 0.906⁴ |
| Z    | NIRAv2 [7] | MLMF  | Single      | -0.176  | 0.203  | -0.0191 | 0.901⁴ |
| a    | Blur kernel [17] | SFM   | Single      | 0.184   | 0.152  | 0.279 | 8.88  |
| b    | Blur kernel with sliding window [18] | SFM   | Single      | 0.0187  | 0.138  | 0.106 | 0.438 |
| c    | Temporal dynamics [19] | SFM   | Single      | -0.257  | 0.178  | 0.35  | 0.365 |
| d    | Improved blind RTE [6] | ABC   | Single      | -0.0357 | 0.164  | 0.167 | 0.0269 |
| e    | SDD [20] | SFM   | Single      | 0.593   | 52.8   | 0.0524 | 0.0224 |
3.1.3 Fan noise

Figure 15: Fullband $T_{60}$ estimation error in fan noise for all SNRs
| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE | $\rho$ | RTF |
|------|-----------|-------|--------------|------|-----|-------|-----|
| A    | QA Reverb [11] | SFM   | Single       | -0.0276 | 0.0672 | 0.746 | 0.4 |
| B    | Octave SB-based FB RTE [3] | ABC   | Single       | -0.0881 | 0.0811 | 0.647 | 0.903 |
| C    | DCT-based FB RTE [3] | ABC   | Single       | -0.109 | 0.0843 | 0.659 | 0.984 |
| D    | Model-based SB RTE [3] | ABC   | Single       | 0.0204 | 0.118 | 0.55 | 0.433 |
| E    | Baseline algorithm for FB RTE [3] | ABC   | Single       | -0.065 | 0.112 | 0.383 | 0.0421 |
| F    | SDDSA-G retrained [12] | SFM   | Single       | 0.0629 | 0.13 | 0.484 | 0.0148 |
| G    | SDDSA-G [13] | SFM   | Single       | -0.00884 | 0.0952 | 0.488 | 0.0164 |
| H    | Multi-layer perceptron P2 [14] | MLMF  | Single       | -0.097 | 0.108 | 0.451 | 0.0578 |
| I    | Multi-layer perceptron P2 [14] | MLMF  | Single       | -0.0197 | 0.109 | 0.359 | 0.0578 |
| J    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook   | -0.0382 | 0.0971 | 0.486 | 0.059 |
| K    | Multi-layer perceptron P2 [14] | MLMF  | Mobile       | -0.00714 | 0.0864 | 0.396 | 0.0555 |
| L    | Multi-layer perceptron P2 [14] | MLMF  | Crucif       | -0.0224 | 0.108 | 0.364 | 0.0569 |
| M    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch       | -0.031 | 0.0925 | 0.384 | 0.0617 |
| N    | Multi-layer perceptron P2 [14] | MLMF  | EM32         | -0.0268 | 0.0945 | 0.339 | 0.0574 |
| O    | Per acoust. band SRMR Sec. 2.5 [15] | SFM   | Single       | -0.0853 | 0.114 | 0.367 | 0.576 |
| P    | NSRMR Sec. 2.4 [16, 15] | SFM   | Single       | -0.054 | 0.125 | 0.195 | 0.569 |
| Q    | NSRMR Sec. 2.4 [16, 15] | SFM   | Chromebook   | 0.0352 | 0.122 | 0.26 | 1.03 |
| R    | NSRMR Sec. 2.4 [16, 15] | SFM   | Mobile       | -0.0389 | 0.102 | 0.204 | 1.58 |
| S    | NSRMR Sec. 2.4 [16, 15] | SFM   | Crucif       | -0.0411 | 0.113 | 0.177 | 2.61 |
| T    | SRMR Sec. 2.3 [15] | SFM   | Single       | -0.156 | 0.145 | 0.188 | 0.455 |
| U    | SRMR Sec. 2.3 [15] | SFM   | Chromebook   | -0.0922 | 0.131 | 0.218 | 0.824 |
| V    | SRMR Sec. 2.3 [15] | SFM   | Mobile       | -0.149 | 0.123 | 0.185 | 1.26 |
| W    | SRMR Sec. 2.3 [15] | SFM   | Crucif       | -0.149 | 0.13 | 0.188 | 2.08 |
| X    | NIRAv3 [7] | MLMF  | Single       | -0.215 | 0.159 | 0.283 | 0.895 |
| Y    | NIRAv1 [7] | MLMF  | Single       | -0.22 | 0.164 | 0.247 | 0.895 |
| Z    | NIRAv2 [7] | MLMF  | Single       | -0.179 | 0.192 | 0.0105 | 0.906 |
| a    | Blur kernel [17] | SFM   | Single       | 0.172 | 0.149 | 0.285 | 8.36 |
| b    | Blur kernel with sliding window [18] | SFM | Single | -0.0198 | 0.142 | 0.111 | 0.412 |
| c    | Temporal dynamics [19] | SFM   | Single       | -0.295 | 0.217 | 0.191 | 0.358 |
| d    | Improved blind RTE [6] | ABC   | Single       | -0.0795 | 0.165 | 0.172 | 0.0254 |
| e    | SDD [20] | SFM   | Single       | 1.31 | 861 | -0.0141 | 0.0221 |
3.2 Fullband $T_{60}$ estimation results by noise type and SNR

3.2.1 Ambient noise at 18 dB SNR

Figure 16: Fullband $T_{60}$ estimation error in ambient noise at 18 dB SNR
Table 12: $T_{60}$ estimation algorithm performance in ambient noise at 18 dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE  | $\rho$ | RTF |
|------|-----------|-------|-------------|------|------|-------|-----|
| A    | QA Reverb [11] | SFM | Single | -0.0913 | 0.0519 | 0.893 | 0.401 |
| B    | Octave SB-based FB RTE [3] | ABC | Single | -0.0979 | 0.0647 | 0.788 | 1.04 |
| C    | DCT-based FB RTE [3] | ABC | Single | -0.0934 | 0.0712 | 0.724 | 1.04 |
| D    | Model-based SB RTE [3] | ABC | Single | -0.0274 | 0.0815 | 0.759 | 0.478 |
| E    | Baseline algorithm for FB RTE [3] | ABC | Single | -0.0705 | 0.0959 | 0.509 | 0.0421 |
| F    | SDDSA-G retrained [12] | SFM | Single | -0.0554 | 0.0593 | 0.78 | 0.0153 |
| G    | SDDSA-G [13] | SFM | Single | -0.107 | 0.0591 | 0.804 | 0.0166 |
| H    | Multi-layer perceptron [14] | MLMF | Single | -0.11 | 0.0927 | 0.588 | 0.0578 |
| I    | Multi-layer perceptron P2 [14] | MLMF | Single | -0.0815 | 0.0947 | 0.537 | 0.0578 |
| J    | Multi-layer perceptron P2 [14] | MLMF | Chromebook | -0.1 | 0.0816 | 0.678 | 0.0589 |
| K    | Multi-layer perceptron P2 [14] | MLMF | Mobile | -0.0493 | 0.0781 | 0.499 | 0.0557 |
| L    | Multi-layer perceptron P2 [14] | MLMF | Crucif | -0.0853 | 0.0946 | 0.543 | 0.0569 |
| M    | Multi-layer perceptron P2 [14] | MLMF | Lin8Ch | -0.0793 | 0.0855 | 0.488 | 0.062 |
| N    | Multi-layer perceptron P2 [14] | MLMF | EM32 | -0.0906 | 0.0806 | 0.54 | 0.0578 |
| O    | Per acoust. band SRMR Sec. 2.5. [15] | SFM | Single | -0.191 | 0.118 | 0.655 | 0.58 |
| P    | NSRMR Sec. 2.4. [16, 15] | SFM | Single | -0.128 | 0.123 | 0.374 | 0.571 |
| Q    | NSRMR Sec. 2.4. [16, 15] | SFM | Chromebook | -0.0736 | 0.113 | 0.41 | 1.04 |
| R    | NSRMR Sec. 2.4. [16, 15] | SFM | Mobile | -0.118 | 0.0961 | 0.436 | 1.59 |
| S    | NSRMR Sec. 2.4. [16, 15] | SFM | Crucif | -0.115 | 0.109 | 0.363 | 2.63 |
| T    | SRMR Sec. 2.3. [15] | SFM | Single | -0.221 | 0.16 | 0.312 | 0.457 |
| U    | SRMR Sec. 2.3. [15] | SFM | Chromebook | -0.186 | 0.15 | 0.29 | 0.831 |
| V    | SRMR Sec. 2.3. [15] | SFM | Mobile | -0.219 | 0.136 | 0.346 | 1.26 |
| W    | SRMR Sec. 2.3. [15] | SFM | Crucif | -0.215 | 0.144 | 0.336 | 2.09 |
| X    | NIRAv3 [7] | MLMF | Single | -0.268 | 0.172 | 0.442 | 0.897 |
| Y    | NIRAv1 [7] | MLMF | Single | -0.245 | 0.164 | 0.408 | 0.897 |
| Z    | NIRAv2 [7] | MLMF | Single | -0.183 | 0.199 | -0.0283 | 0.912 |
| a    | Blur kernel [17] | SFM | Single | 0.0888 | 0.0989 | 0.513 | 8.16 |
| b    | Blur kernel with sliding window [18] | SFM | Single | -0.045 | 0.104 | 0.421 | 0.413 |
| c    | Temporal dynamics [19] | SFM | Single | -0.387 | 0.253 | 0.429 | 0.362 |
| d    | Improved blind RTE [6] | ABC | Single | -0.128 | 0.132 | 0.354 | 0.0255 |
| e    | SDD [20] | SFM | Single | -0.508 | 0.329 | 0.644 | 0.0219 |
3.2.2 Ambient noise at 12 dB SNR

Figure 17: Fullband $T_{60}$ estimation error in ambient noise at 12 dB SNR
Table 13: $T_{60}$ estimation algorithm performance in ambient noise at 12 dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias   | MSE    | $\rho$ | RTF   |
|------|-----------|-------|--------------|--------|--------|--------|-------|
| A    | QA Reverb [11] | SFM   | Single       | -0.0795 | 0.0543 | 0.873  | 0.401 |
| B    | Octave SB-based FB RTE [3] | ABC   | Single       | -0.1    | 0.0657 | 0.786  | 1     |
| C    | DCT-based FB RTE [3] | ABC   | Single       | -0.0967 | 0.069  | 0.748  | 1.04  |
| D    | Model-based SB RTE [3] | ABC   | Single       | -0.0281 | 0.0864 | 0.733  | 0.478 |
| E    | Baseline algorithm for FB RTE [3] | ABC   | Single       | -0.0527 | 0.0955 | 0.499  | 0.0421 |
| F    | SDDSA-G retrained [12] | SFM   | Single       | -0.133  | 0.0629 | 0.796  | 0.0153 |
| G    | SDDSA-G [13] | SFM   | Single       | -0.157  | 0.075  | 0.808  | 0.0166 |
| H    | Multi-layer perceptron [14] | MLMF  | Single       | -0.117  | 0.0888 | 0.629  | 0.0578 |
| I    | Multi-layer perceptron P2 [14] | MLMF  | Single       | -0.0899 | 0.0935 | 0.556  | 0.0578 |
| J    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook   | -0.097  | 0.0827 | 0.659  | 0.0589 |
| K    | Multi-layer perceptron P2 [14] | MLMF  | Mobile       | -0.0631 | 0.0781 | 0.514  | 0.0557 |
| L    | Multi-layer perceptron P2 [14] | MLMF  | Crucif       | -0.0917 | 0.0927 | 0.565  | 0.0569 |
| M    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch       | -0.0873 | 0.0852 | 0.505  | 0.062 |
| N    | Multi-layer perceptron P2 [14] | MLMF  | EM32         | -0.103  | 0.0821 | 0.549  | 0.0578 |
| O    | Per acoust. band SRMR Sec. 2.5. [15] | SFM   | Single       | -0.18   | 0.115  | 0.64   | 0.58  |
| P    | NSRMR Sec. 2.4. [16] [15] | SFM   | Single       | -0.121  | 0.122  | 0.36   | 0.571 |
| Q    | NSRMR Sec. 2.4. [16] [15] | SFM   | Chromebook   | -0.0575 | 0.11   | 0.42   | 1.04  |
| R    | NSRMR Sec. 2.4. [16] [15] | SFM   | Mobile       | -0.111  | 0.0956 | 0.42   | 1.59  |
| S    | NSRMR Sec. 2.4. [16] [15] | SFM   | Crucif       | -0.109  | 0.109  | 0.345  | 2.63  |
| T    | SRMR Sec. 2.3. [15] | SFM   | Single       | -0.215  | 0.158  | 0.305  | 0.457 |
| U    | SRMR Sec. 2.3. [15] | SFM   | Chromebook   | -0.171  | 0.143  | 0.314  | 0.831 |
| V    | SRMR Sec. 2.3. [15] | SFM   | Mobile       | -0.212  | 0.133  | 0.338  | 1.26  |
| W    | SRMR Sec. 2.3. [15] | SFM   | Crucif       | -0.209  | 0.142  | 0.324  | 2.09  |
| X    | NIRAv3 [7] | MLMF  | Single       | -0.273  | 0.176  | 0.433  | 0.897 |
| Y    | NIRAv1 [7] | MLMF  | Single       | -0.25   | 0.167  | 0.399  | 0.897 |
| Z    | NIRAv2 [7] | MLMF  | Single       | -0.189  | 0.196  | -0.0487 | 0.912 |
| a    | Blur kernel [17] | SFM   | Single       | 0.161   | 0.138  | 0.35   | 8.16  |
| b    | Blur kernel with sliding window [18] | SFM   | Single       | -0.0199 | 0.117  | 0.254  | 0.413 |
| c    | Temporal dynamics [19] | SFM   | Single       | -0.382  | 0.25   | 0.423  | 0.362 |
| d    | Improved blind RTE [6] | ABC   | Single       | -0.0994 | 0.147  | 0.249  | 0.0255 |
| e    | SDD [20] | SFM   | Single       | -0.518  | 0.356  | 0.539  | 0.0219 |
3.2.3 Ambient noise at $-1$ dB SNR

Figure 18: Fullband $T_{60}$ estimation error in ambient noise at $-1$ dB SNR
Table 14: $T_{60}$ estimation algorithm performance in ambient noise at $-1$ dB SNR

| Ref. | Algorithm | Class   | Mic. Config. | Bias   | MSE    | $\rho$ | RTF  |
|------|-----------|---------|--------------|--------|--------|--------|------|
| A    | QA Reverb [11] | SFM     | Single       | -0.0339 | 0.0634 | 0.757  | 0.401 |
| B    | Octave SB-based FB RTE [13] | ABC    | Single       | -0.0997 | 0.0735 | 0.733  | 1    |
| C    | DCT-based FB RTE [1]   | ABC    | Single       | -0.103  | 0.0812 | 0.673  | 1.04 |
| D    | Model-based SB RTE [13] | ABC    | Single       | -0.0102 | 0.0994 | 0.655  | 0.478 |
| E    | Baseline algorithm for FB RTE [3] | ABC    | Single       | -0.0001 | 0.124  | 0.285  | 0.0421 |
| F    | SDDSA-G retrained [12] | SFM    | Single       | -0.0564 | 0.0806 | 0.62   | 0.0153 |
| G    | SDDSA-G [13] | SFM    | Single       | -0.0867 | 0.0874 | 0.592  | 0.0166 |
| H    | Multi-layer perceptron [14] | MLMF   | Single       | -0.147  | 0.112  | 0.516  | 0.0578$^2$ |
| I    | Multi-layer perceptron P2 [14] | MLMF   | Single       | -0.0819 | 0.103  | 0.47   | 0.0578$^2$ |
| J    | Multi-layer perceptron P2 [14] | MLMF   | Chromebook   | -0.0138 | 0.111  | 0.379  | 0.0589$^4$ |
| K    | Multi-layer perceptron P2 [14] | MLMF   | Mobile       | -0.0619 | 0.0834 | 0.471  | 0.0557$^4$ |
| L    | Multi-layer perceptron P2 [14] | MLMF   | Crucif       | -0.0787 | 0.104  | 0.455  | 0.0569$^4$ |
| M    | Multi-layer perceptron P2 [14] | MLMF   | Lin8Ch       | -0.0787 | 0.0812 | 0.53   | 0.062 |
| N    | Multi-layer perceptron P2 [14] | MLMF   | EM32         | -0.0972 | 0.0894 | 0.474  | 0.0578$^7$ |
| O    | Per acoust. band SRMR Sec. 2.5. [15] | SFM    | Single       | -0.108  | 0.106  | 0.499  | 0.58 |
| P    | NSRMR Sec. 2.4. [16, 15] | SFM    | Single       | -0.0403 | 0.124  | 0.157  | 0.571 |
| Q    | NSRMR Sec. 2.4. [16, 15] | SFM    | Chromebook   | 0.118   | 0.125  | 0.356  | 1.04 |
| R    | NSRMR Sec. 2.4. [16, 15] | SFM    | Mobile       | -0.022  | 0.101  | 0.163  | 1.59 |
| S    | NSRMR Sec. 2.4. [16, 15] | SFM    | Crucif       | -0.0271 | 0.111  | 0.148  | 2.63 |
| T    | SRMR Sec. 2.3. [15] | SFM    | Single       | -0.148  | 0.142  | 0.164  | 0.457 |
| U    | SRMR Sec. 2.3. [15] | SFM    | Chromebook   | -0.0332 | 0.114  | 0.348  | 0.831 |
| V    | SRMR Sec. 2.3. [15] | SFM    | Mobile       | -0.135  | 0.117  | 0.159  | 1.26 |
| W    | SRMR Sec. 2.3. [15] | SFM    | Crucif       | -0.14   | 0.126  | 0.178  | 2.09 |
| X    | NIRAv3 [7]  | MLMF   | Single       | -0.248  | 0.168  | 0.359  | 0.897$^4$ |
| Y    | NIRAv1 [7]  | MLMF   | Single       | -0.235  | 0.167  | 0.298  | 0.897$^4$ |
| Z    | NIRAv2 [7]  | MLMF   | Single       | -0.177  | 0.198  | -0.085 | 0.912$^2$ |
| a    | Blur kernel [17] | SFM    | Single       | 0.242   | 0.214  | -0.0718 | 8.16 |
| b    | Blur kernel with sliding window [18] | SFM    | Single       | 0.0183  | 0.188  | -0.0244 | 0.413 |
| c    | Temporal dynamics [19] | SFM    | Single       | -0.307  | 0.214  | 0.211  | 0.362 |
| d    | Improved blind RTE [6] | ABC    | Single       | 0.00207 | 0.224  | -0.0319 | 0.0255 |
| e    | SDD [20]    | SFM    | Single       | -0.518  | 0.381  | 0.387  | 0.0219 |
3.2.4 Babble noise at 18 dB SNR

Figure 19: Fullband $T_{60}$ estimation error in babble noise at 18 dB SNR
Table 15: $T_{60}$ estimation algorithm performance in babble noise at 18 dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias  | MSE   | $\rho$  | RTF  |
|------|-----------|-------|--------------|-------|-------|--------|------|
| A    | QA Reverb [11] | SFM   | Single       | -0.0854 | 0.058 | 0.873  | 0.398 |
| B    | Octave SB-based FB RTE [3] | ABC   | Single       | -0.112  | 0.064 | 0.826  | 0.911 |
| C    | DCT-based FB RTE [3] | ABC   | Single       | -0.1  | 0.0698 | 0.756  | 0.99  |
| D    | Model-based SB RTE [3] | ABC   | Single       | -0.0545 | 0.0852 | 0.758  | 0.443 |
| E    | Baseline algorithm for FB RTE [3] | ABC   | Single       | -0.0546 | 0.102 | 0.448  | 0.0428 |
| F    | SDDSA-G retrained [12] | SFM   | Single       | 0.0931 | 0.0836 | 0.713  | 0.0155 |
| G    | SDDSA-G [13] | SFM   | Single       | 0.0104 | 0.0681 | 0.674  | 0.0162 |
| H    | Multi-layer perceptron [14] | MLMF  | Single       | -0.054 | 0.098 | 0.474  | 0.0579 |
| I    | Multi-layer perceptron P2 [14] | MLMF  | Single       | -0.0373 | 0.0974 | 0.467  | 0.0579 |
| J    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook   | -0.056  | 0.0891 | 0.562  | 0.0588 |
| K    | Multi-layer perceptron P2 [14] | MLMF  | Mobile       | -0.0197 | 0.086 | 0.394  | 0.0555 |
| L    | Multi-layer perceptron P2 [14] | MLMF  | Crucif       | -0.0431 | 0.097 | 0.474  | 0.057 |
| M    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch  | -0.0359 | 0.0897 | 0.403  | 0.0618 |
| N    | Multi-layer perceptron P2 [14] | MLMF  | EM32       | -0.0518 | 0.0876 | 0.42   | 0.0576 |
| O    | Per acoust. band SRMR Sec. 2.5. [15] | SFM   | Single       | -0.152  | 0.108 | 0.648  | 0.579 |
| P    | NSRMR Sec. 2.4. [16, 15] | SFM   | Single       | -0.116  | 0.119 | 0.391  | 0.572 |
| Q    | NSRMR Sec. 2.4. [16, 15] | SFM   | Chromebook   | -0.0642 | 0.111 | 0.414  | 1.04  |
| R    | NSRMR Sec. 2.4. [16, 15] | SFM   | Mobile       | -0.106  | 0.0924 | 0.454  | 1.58  |
| S    | NSRMR Sec. 2.4. [16, 15] | SFM   | Crucif       | -0.104  | 0.105 | 0.385  | 2.63  |
| T    | SRMR Sec. 2.3. [15] | SFM   | Single       | -0.207  | 0.152 | 0.329  | 0.457 |
| U    | SRMR Sec. 2.3. [15] | SFM   | Chromebook   | -0.173  | 0.145 | 0.29   | 0.833 |
| V    | SRMR Sec. 2.3. [15] | SFM   | Mobile       | -0.204  | 0.128 | 0.367  | 1.26  |
| W    | SRMR Sec. 2.3. [15] | SFM   | Crucif       | -0.2  | 0.137 | 0.356  | 2.1   |
| X    | NIRAv3 [7] | MLMF  | Single       | -0.14  | 0.133 | 0.33   | 0.906 |
| Y    | NIRAv1 [7] | MLMF  | Single       | -0.126  | 0.132 | 0.288  | 0.906 |
| Z    | NIRAv2 [7] | MLMF  | Single       | -0.176  | 0.228 | -0.134 | 0.901 |
| a    | Blur kernel [17] | SFM   | Single       | 0.102  | 0.107 | 0.472  | 8.88  |
| b    | Blur kernel with sliding window [18] | SFM   | Single       | -0.026  | 0.108 | 0.356  | 0.438 |
| c    | Temporal dynamics [19] | SFM   | Single       | -0.375 | 0.243 | 0.445  | 0.365 |
| d    | Improved blind RTE [6] | ABC   | Single       | -0.104  | 0.126 | 0.355  | 0.0269 |
| e    | SDD [20] | SFM   | Single       | 0.793  | 141  | 0.105  | 0.0224 |
3.2.5 Babble noise at 12 dB SNR

Figure 20: Fullband $T_{60}$ estimation error in babble noise at 12 dB SNR
Table 16: $T_{60}$ estimation algorithm performance in babble noise at 12 dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE | $\rho$ | RTF |
|------|-----------|-------|--------------|------|-----|-------|-----|
| A    | QA Reverb [11] | SFM | Single | -0.0796 | 0.0609 | 0.851 | 0.398 |
| B    | Octave SB-based FB RTE [3] | ABC | Single | -0.128 | 0.0735 | 0.802 | 0.911 |
| C    | DCT-based FB RTE [3] | ABC | Single | -0.11 | 0.0737 | 0.751 | 0.99 |
| D    | Model-based SB RTE [3] | ABC | Single | -0.0572 | 0.0884 | 0.741 | 0.443 |
| E    | Baseline algorithm for FB RTE [3] | ABC | Single | -0.0458 | 0.108 | 0.389 | 0.0428 |
| F    | SDDSA-G retrained [12] | SFM | Single | 0.0875 | 0.113 | 0.577 | 0.0155 |
| G    | SDDSA-G [13] | SFM | Single | 0.0122 | 0.0819 | 0.578 | 0.0162 |
| H    | Multi-layer perceptron [14] | MLMF | Single | -0.0609 | 0.103 | 0.443 | 0.0579 |
| I    | Multi-layer perceptron P2 [14] | MLMF | Single | -0.0513 | 0.0934 | 0.514 | 0.0579 |
| J    | Multi-layer perceptron P2 [14] | MLMF | Chromebook | -0.0474 | 0.0898 | 0.548 | 0.0588 |
| K    | Multi-layer perceptron P2 [14] | MLMF | Mobile | -0.0195 | 0.079 | 0.468 | 0.0555 |
| L    | Multi-layer perceptron P2 [14] | MLMF | Crucif | -0.0445 | 0.0961 | 0.483 | 0.057 |
| M    | Multi-layer perceptron P2 [14] | MLMF | Lin8Ch | -0.023 | 0.0843 | 0.447 | 0.0618 |
| N    | Multi-layer perceptron P2 [14] | MLMF | EM32 | -0.0616 | 0.0856 | 0.453 | 0.0576 |
| O    | Per acoust. band SRMR Sec. 2.5. [15] | SFM | Single | -0.11 | 0.101 | 0.647 | 0.579 |
| P    | NSRMR Sec. 2.4. [16, 15] | SFM | Single | -0.0862 | 0.112 | 0.422 | 0.572 |
| Q    | NSRMR Sec. 2.4. [16, 15] | SFM | Chromebook | -0.0337 | 0.107 | 0.449 | 1.04 |
| R    | NSRMR Sec. 2.4. [16, 15] | SFM | Mobile | -0.0739 | 0.0856 | 0.484 | 1.58 |
| S    | NSRMR Sec. 2.4. [16, 15] | SFM | Crucif | -0.0736 | 0.098 | 0.429 | 2.63 |
| T    | SRMR Sec. 2.3. [13] | SFM | Single | -0.173 | 0.138 | 0.363 | 0.457 |
| U    | SRMR Sec. 2.3. [13] | SFM | Chromebook | -0.135 | 0.132 | 0.344 | 0.833 |
| V    | SRMR Sec. 2.3. [13] | SFM | Mobile | -0.166 | 0.113 | 0.4 | 1.26 |
| W    | SRMR Sec. 2.3. [13] | SFM | Crucif | -0.164 | 0.122 | 0.4 | 2.1 |
| X    | NIRAv3 [7] | MLMF | Single | -0.108 | 0.12 | 0.371 | 0.906 |
| Y    | NIRAv1 [7] | MLMF | Single | -0.0969 | 0.122 | 0.327 | 0.906 |
| Z    | NIRAv2 [7] | MLMF | Single | -0.167 | 0.196 | 0.00486 | 0.901 |
| a    | Blur kernel [17] | SFM | Single | 0.187 | 0.148 | 0.305 | 8.88 |
| b    | Blur kernel with sliding window [18] | SFM | Single | 0.00866 | 0.127 | 0.131 | 0.438 |
| c    | Temporal dynamics [19] | SFM | Single | -0.344 | 0.218 | 0.472 | 0.365 |
| d    | Improved blind RTE [6] | ABC | Single | -0.0563 | 0.145 | 0.224 | 0.0269 |
| e    | SDD [20] | SFM | Single | 0.458 | 5.11 | 0.153 | 0.0224 |
3.2.6 Babble noise at $-1 \text{ dB SNR}$

Figure 21: Fullband $T_{60}$ estimation error in babble noise at $-1 \text{ dB SNR}$
Table 17: $T_{60}$ estimation algorithm performance in babble noise at $-1$ dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE   | $\rho$ | RTF |
|------|-----------|-------|--------------|------|-------|-------|-----|
| A    | QA Reverb [11] | SFM   | Single       | -0.162 | 0.0934 | 0.759  | 0.398 |
| B    | Octave SB-based FB RTE [3] | ABC   | Single       | -0.13  | 0.0727 | 0.802  | 0.911 |
| C    | DCT-based FB RTE [3] | ABC   | Single       | -0.108 | 0.072  | 0.759  | 0.99  |
| D    | Model-based SB RTE [3] | ABC   | Single       | -0.0602 | 0.0895 | 0.731  | 0.443 |
| E    | Baseline algorithm for FB RTE [3] | ABC   | Single       | 0.0297 | 0.127  | 0.281  | 0.0428 |
| F    | SDDSA-G retrained [12] | SFM   | Single       | 0.0259 | 0.0541 | 0.757  | 0.0155 |
| G    | SDDSA-G [13] | SFM   | Single       | -0.0249 | 0.0655 | 0.7    | 0.0162 |
| H    | Multi-layer perceptron [14] | MLMF  | Single       | -0.0903 | 0.119  | 0.345  | 0.0579* |
| I    | Multi-layer perceptron P2 [14] | MLMF  | Single       | -0.0465 | 0.0853 | 0.577  | 0.0579* |
| J    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook   | -0.0568 | 0.0945 | 0.52   | 0.0588* |
| K    | Multi-layer perceptron P2 [14] | MLMF  | Mobile       | -0.0339 | 0.0738 | 0.528  | 0.0555* |
| L    | Multi-layer perceptron P2 [14] | MLMF  | Crucif       | -0.0419 | 0.0912 | 0.523  | 0.057*  |
| M    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch       | -0.0241 | 0.078  | 0.506  | 0.0618* |
| N    | Multi-layer perceptron P2 [14] | MLMF  | EM32         | -0.0572 | 0.0826 | 0.478  | 0.0576* |
| O    | Per acoust. band SRMR Sec. 2.5. [15] | SFM   | Single       | -0.0282 | 0.0888 | 0.81   | 0.579 |
| P    | NSRMR Sec. 2.4, 16, 15 [16] | SFM   | Single       | 0.0712 | 0.0987 | 0.777  | 0.572 |
| Q    | NSRMR Sec. 2.4, 16, 15 [16] | SFM   | Chromebook   | 0.113  | 0.113  | 0.783  | 1.04  |
| R    | NSRMR Sec. 2.4, 16, 15 [16] | SFM   | Mobile       | 0.0935 | 0.0841 | 0.801  | 1.58  |
| S    | NSRMR Sec. 2.4, 16, 15 [16] | SFM   | Crucif       | 0.0871 | 0.0905 | 0.828  | 2.63  |
| T    | SRMR Sec. 2.3, 15 [15] | SFM   | Single       | -0.00916 | 0.108  | 0.617  | 0.457 |
| U    | SRMR Sec. 2.3, 15 [15] | SFM   | Chromebook   | 0.029  | 0.111  | 0.687  | 0.833 |
| V    | SRMR Sec. 2.3, 15 [15] | SFM   | Mobile       | 0.00906 | 0.0867 | 0.671  | 1.26  |
| W    | SRMR Sec. 2.3, 15 [15] | SFM   | Crucif       | 0.00276 | 0.0948 | 0.687  | 2.1   |
| X    | NIRAv3 [7] | MLMF  | Single       | -0.0413 | 0.109  | 0.377  | 0.906 |
| Y    | NIRAv1 [7] | MLMF  | Single       | -0.0465 | 0.119  | 0.279  | 0.906 |
| Z    | NIRAv2 [7] | MLMF  | Single       | -0.184 | 0.185  | 0.0865 | 0.901 |
| a    | Blur kernel [17] | SFM   | Single       | 0.263  | 0.201  | 0.0261 | 8.88  |
| b    | Blur kernel with sliding window [18] | SFM   | Single       | 0.0733 | 0.178  | -0.0263 | 0.438 |
| c    | Temporal dynamics [19] | SFM   | Single       | -0.053 | 0.0728 | 0.713  | 0.365 |
| d    | Improved blind RTE [6] | ABC   | Single       | 0.0536 | 0.219  | 0.0134 | 0.0269 |
| e    | SDD [20] | SFM   | Single       | 0.529  | 12.5   | -0.131 | 0.0224 |
3.2.7 Fan noise at 18 dB SNR

Figure 22: Fullband $T_{60}$ estimation error in fan noise at 18 dB SNR
Table 18: $T_{60}$ estimation algorithm performance in fan noise at 18 dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE  | $\rho$ | RTF |
|------|-----------|-------|--------------|------|------|--------|-----|
| A    | QA Reverb [11] | SFM | Single | -0.0649 | 0.055 | 0.867 | 0.4 |
| B    | Octave SB-based FB RTE [4] | ABC | Single | -0.111 | 0.0666 | 0.798 | 0.903 |
| C    | DCT-based FB RTE [3] | ABC | Single | -0.106 | 0.0705 | 0.755 | 0.984 |
| D    | Model-based SB RTE [3] | ABC | Single | -0.0363 | 0.0869 | 0.737 | 0.433 |
| E    | Baseline algorithm for FB RTE [3] | ABC | Single | -0.079 | 0.098 | 0.503 | 0.0421 |
| F    | SDDSA-G retrained [12] | SFM | Single | 0.0258 | 0.0717 | 0.719 | 0.0148 |
| G    | SDDSA-G [13] | SFM | Single | -0.0387 | 0.0666 | 0.696 | 0.0164 |
| H    | Multi-layer perceptron [14] | MLMF | Single | -0.0699 | 0.0938 | 0.525 | 0.0578 |
| I    | Multi-layer perceptron P2 [14] | MLMF | Single | -0.0325 | 0.102 | 0.421 | 0.0578 |
| J    | Multi-layer perceptron P2 [14] | MLMF | Chromebook | -0.0706 | 0.0843 | 0.614 | 0.059 |
| K    | Multi-layer perceptron P2 [14] | MLMF | Mobile | -0.0177 | 0.0821 | 0.435 | 0.0555 |
| L    | Multi-layer perceptron P2 [14] | MLMF | Crucif | -0.0371 | 0.103 | 0.418 | 0.0569 |
| M    | Multi-layer perceptron P2 [14] | MLMF | Lin8Ch | -0.0477 | 0.0931 | 0.381 | 0.0617 |
| N    | Multi-layer perceptron P2 [14] | MLMF | EM32 | -0.0406 | 0.0872 | 0.411 | 0.0574 |
| O    | Per acoust. band SRMR Sec. 2.3. [15] | SFM | Single | -0.174 | 0.115 | 0.627 | 0.576 |
| P    | NSRMR Sec. 2.4. [16, 15] | SFM | Single | -0.124 | 0.122 | 0.37 | 0.569 |
| Q    | NSRMR Sec. 2.4. [16, 15] | SFM | Chromebook | -0.0681 | 0.111 | 0.422 | 1.03 |
| R    | NSRMR Sec. 2.4. [16, 15] | SFM | Mobile | -0.114 | 0.0956 | 0.431 | 1.58 |
| S    | NSRMR Sec. 2.4. [16, 15] | SFM | Crucif | -0.112 | 0.109 | 0.358 | 2.61 |
| T    | SRMR Sec. 2.3. [15] | SFM | Single | -0.217 | 0.158 | 0.309 | 0.455 |
| U    | SRMR Sec. 2.3. [15] | SFM | Chromebook | -0.179 | 0.146 | 0.312 | 0.824 |
| V    | SRMR Sec. 2.3. [15] | SFM | Mobile | -0.215 | 0.134 | 0.342 | 1.26 |
| W    | SRMR Sec. 2.3. [15] | SFM | Crucif | -0.211 | 0.142 | 0.33 | 2.08 |
| X    | NIRAv3 [7] | MLMF | Single | -0.223 | 0.157 | 0.355 | 0.895 |
| Y    | NIRAv1 [7] | MLMF | Single | -0.207 | 0.153 | 0.315 | 0.895 |
| Z    | NIRAv2 [7] | MLMF | Single | -0.164 | 0.201 | -0.0474 | 0.906 |
| a    | Blur kernel [17] | SFM | Single | 0.0893 | 0.103 | 0.48 | 8.36 |
| b    | Blur kernel with sliding window [18] | SFM | Single | -0.0394 | 0.109 | 0.35 | 0.412 |
| c    | Temporal dynamics [19] | SFM | Single | -0.384 | 0.251 | 0.427 | 0.358 |
| d    | Improved blind RTE [6] | ABC | Single | -0.134 | 0.133 | 0.354 | 0.0254 |
| e    | SDD [20] | SFM | Single | 0.666 | 28.5 | 0.0185 | 0.0221 |
3.2.8 Fan noise at 12 dB SNR

Figure 23: Fullband $T_{60}$ estimation error in fan noise at 12 dB SNR
Table 19: $T_{60}$ estimation algorithm performance in fan noise at 12 dB SNR

| Ref. | Algorithm | Class  | Mic. Config. | Bias | MSE  | $\rho$ | RTF |
|------|-----------|--------|--------------|------|------|--------|-----|
| A    | QA Reverb [11] | SFM    | Single       | -0.0315 | 0.0622 | 0.8    | 0.4 |
| B    | Octave SB-based FB RTE [3] | ABC    | Single       | -0.114 | 0.0755 | 0.744 | 0.903 |
| C    | DCT-based FB RTE [3] | ABC    | Single       | -0.117 | 0.0803 | 0.705 | 0.984 |
| D    | Model-based SB RTE [3] | ABC    | Single       | -0.0233 | 0.0974 | 0.673 | 0.433 |
| E    | Baseline algorithm for FB RTE [3] | ABC    | Single       | -0.0834 | 0.103 | 0.465 | 0.0421 |
| F    | SDDSA-G retrained [12] | SFM    | Single       | -0.05  | 0.0707 | 0.671 | 0.0148 |
| G    | SDDSA-G [13] | SFM    | Single       | -0.0808 | 0.0782 | 0.66  | 0.0164 |
| H    | Multi-layer perceptron P2 [14] | MLMF   | Single       | -0.08  | 0.0975 | 0.508  | 0.0578 |
| J    | Multi-layer perceptron P2 [14] | MLMF   | Chromebook   | -0.0644 | 0.0894 | 0.565  | 0.0599 |
| K    | Multi-layer perceptron P2 [14] | MLMF   | Mobile       | -0.00734 | 0.0834 | 0.422  | 0.0555 |
| L    | Multi-layer perceptron P2 [14] | MLMF   | Crucif       | -0.0295 | 0.103 | 0.414  | 0.0569 |
| M    | Multi-layer perceptron P2 [14] | MLMF   | Lin8Ch       | -0.0329 | 0.0913 | 0.391  | 0.0617 |
| N    | Multi-layer perceptron P2 [14] | MLMF   | EM32         | -0.0338 | 0.0891 | 0.392  | 0.0574 |
| O    | Per acoust. band SRMR Sec. 2.5. [15] | SFM    | Single       | -0.132 | 0.109 | 0.554  | 0.576 |
| P    | NSRMR Sec. 2.4. [16, 15] | SFM    | Single       | -0.109 | 0.121 | 0.339  | 0.569 |
| Q    | NSRMR Sec. 2.4. [16, 15] | SFM    | Chromebook   | -0.0388 | 0.106 | 0.452  | 1.03 |
| R    | NSRMR Sec. 2.4. [16, 15] | SFM    | Mobile       | -0.0978 | 0.0944 | 0.396  | 1.58 |
| S    | NSRMR Sec. 2.4. [16, 15] | SFM    | Crucif       | -0.0963 | 0.107 | 0.326  | 2.61 |
| T    | SRMR Sec. 2.3. [15] | SFM    | Single       | -0.201 | 0.153 | 0.293  | 0.455 |
| U    | SRMR Sec. 2.3. [15] | SFM    | Chromebook   | -0.149 | 0.133 | 0.38   | 0.824 |
| V    | SRMR Sec. 2.3. [15] | SFM    | Mobile       | -0.197 | 0.129 | 0.318  | 1.26 |
| W    | SRMR Sec. 2.3. [15] | SFM    | Crucif       | -0.195 | 0.137 | 0.312  | 2.08 |
| X    | NIRAv3 [7] | MLMF   | Single       | -0.216 | 0.155 | 0.337  | 0.895 |
| Y    | NIRAv1 [7] | MLMF   | Single       | -0.206 | 0.155 | 0.293  | 0.895 |
| Z    | NIRAv2 [7] | MLMF   | Single       | -0.188 | 0.188 | 0.0117 | 0.906 |
| a    | Blur kernel [17] | SFM    | Single       | 0.18  | 0.143 | 0.34   | 8.36 |
| b    | Blur kernel with sliding window [18] | SFM    | Single       | -0.0215 | 0.119 | 0.238  | 0.412 |
| c    | Temporal dynamics [19] | SFM    | Single       | -0.371 | 0.242 | 0.409  | 0.358 |
| d    | Improved blind RTE [6] | ABC    | Single       | -0.106 | 0.143 | 0.271  | 0.0254 |
| e    | SDD [20] | SFM    | Single       | 0.918 | 57.2 | 0.0662 | 0.0221 |
3.2.9 Fan noise at –1 dB SNR

Figure 24: Fullband $T_{60}$ estimation error in fan noise at –1 dB SNR
Table 20: $T_{60}$ estimation algorithm performance in fan noise at $-1$ dB SNR

| Ref. | Algorithm                          | Class | Mic. Config. | Bias   | MSE    | $\rho$ | RTF  |
|------|------------------------------------|-------|--------------|--------|--------|--------|------|
| A    | QA Reverb [11]                     | SFM   | Single       | 0.0162 | 0.0844 | 0.609  | 0.4  |
| B    | Octave SB-based FB RTE [3]         | ABC   | Single       | -0.0396| 0.101  | 0.438  | 0.903|
| C    | DCT-based FB RTE [3]               | ABC   | Single       | -0.105 | 0.102  | 0.509  | 0.984|
| D    | Model-based SB RTE [3]             | ABC   | Single       | 0.121  | 0.168  | 0.324  | 0.433|
| E    | Baseline algorithm for FB RTE [3]  | ABC   | Single       | -0.0326| 0.135  | 0.21   | 0.0421|
| F    | SDDSA-G retrained [12]             | SFM   | Single       | 0.213  | 0.247  | 0.196  | 0.0148|
| G    | SDDSA-G [13]                       | SFM   | Single       | 0.093  | 0.141  | 0.22   | 0.0164|
| H    | Multi-layer perceptron [14]        | MLMF  | Single       | -0.141 | 0.133  | 0.337  | 0.0578|
| I    | Multi-layer perceptron P2 [14]     | MLMF  | Single       | 0.000904| 0.12  | 0.264  | 0.0578|
| J    | Multi-layer perceptron P2 [14]     | MLMF  | Chromebook   | 0.0206 | 0.118  | 0.329  | 0.0599|
| K    | Multi-layer perceptron P2 [14]     | MLMF  | Mobile       | 0.00366| 0.0937 | 0.347  | 0.0555|
| L    | Multi-layer perceptron P2 [14]     | MLMF  | Crucif       | -0.000496| 0.119 | 0.276  | 0.0569|
| M    | Multi-layer perceptron P2 [14]     | MLMF  | Lin8Ch       | -0.0123| 0.093  | 0.386  | 0.0617|
| N    | Multi-layer perceptron P2 [14]     | MLMF  | EM32         | -0.00585| 0.107 | 0.229  | 0.0574|
| O    | Per acoust. band SRMR Sec. 2.5. [15]| SFM   | Single       | 0.0497 | 0.117  | 0.251  | 0.576|
| P    | NSRMR Sec. 2.4. [16, 15]           | SFM   | Single       | 0.0712 | 0.132  | 0.0973 | 0.569|
| Q    | NSRMR Sec. 2.4. [16, 15]           | SFM   | Chromebook   | 0.212  | 0.151  | 0.472  | 1.03 |
| R    | NSRMR Sec. 2.4. [16, 15]           | SFM   | Mobile       | 0.0952 | 0.117  | 0.0296 | 1.58 |
| S    | NSRMR Sec. 2.4. [16, 15]           | SFM   | Crucif       | 0.0847 | 0.122  | 0.0702 | 2.61 |
| T    | SRMR Sec. 2.3. [15]                | SFM   | Single       | -0.0493| 0.124  | 0.111  | 0.455|
| U    | SRMR Sec. 2.3. [15]                | SFM   | Chromebook   | 0.0513 | 0.113  | 0.454  | 0.824|
| V    | SRMR Sec. 2.3. [15]                | SFM   | Mobile       | -0.0333| 0.105  | 0.0169 | 1.26 |
| W    | SRMR Sec. 2.3. [15]                | SFM   | Crucif       | -0.0408| 0.111  | 0.0942 | 2.08 |
| X    | NIRAv3 [7]                         | MLMF  | Single       | -0.207 | 0.166  | 0.122  | 0.895|
| Y    | NIRAv1 [7]                         | MLMF  | Single       | -0.246 | 0.184  | 0.115  | 0.895|
| Z    | NIRAv2 [7]                         | MLMF  | Single       | -0.185 | 0.188  | 0.0698 | 0.906|
| a    | Blur kernel [17]                   | SFM   | Single       | 0.248  | 0.201  | 0.0335 | 8.36 |
| b    | Blur kernel with sliding window [18]| SFM   | Single       | 0.00154| 0.198  | -0.0472| 0.412|
| c    | Temporal dynamics [19]             | SFM   | Single       | -0.131 | 0.158  | 0.119  | 0.358|
| d    | Improved blind RTE [6]             | ABC   | Single       | 0.000833| 0.219  | -0.00975| 0.0254|
| e    | SDD [20]                           | SFM   | Single       | 2.35   | 2.5e+03| -0.0369| 0.0221|
3.3 Frequency-dependent $T_{60}$ estimation results

Figure 25: Frequency-dependent $T_{60}$ estimation error in all noises for all SNRs for algorithm Model-based SB RTE [3]
3.4 Frequency-dependent $T_{60}$ estimation results by noise type

3.4.1 Ambient noise

Figure 26: Frequency-dependent $T_{60}$ estimation error in ambient noise for all SNRs for algorithm Model-based SB RTE [3]
3.4.2 Babble noise

Figure 27: Frequency-dependent $T_{60}$ estimation error in babble noise for all SNRs for algorithm Model-based SB RTE.
3.4.3 Fan noise

Figure 28: Frequency-dependent $T_{60}$ estimation error in fan noise for all SNRs for algorithm Model-based SB RTE [3]
3.5 Frequency-dependent $T_{60}$ estimation results by noise type and SNR

3.5.1 Ambient noise at 18 dB

Figure 29: Frequency-dependent $T_{60}$ estimation error in ambient noise at 18 dB SNR for algorithm Model-based SB RTE [3]
3.5.2 Ambient noise at 12 dB

Figure 30: Frequency-dependent $T_{60}$ estimation error in ambient noise at 12 dB SNR for algorithm Model-based SB RTE [3]
3.5.3 Ambient noise at $-1 \, \text{dB}$

Figure 31: Frequency-dependent $T_{60}$ estimation error in ambient noise at $-1 \, \text{dB SNR}$ for algorithm Model-based SB RTE \[3\]
3.5.4 Babble noise at 18 dB

Figure 32: Frequency-dependent $T_{60}$ estimation error in babble noise at 18 dB SNR for algorithm Model-based SB RTE [3]
3.5.5 Babble noise at 12 dB

Figure 33: Frequency-dependent $T_{60}$ estimation error in babble noise at 12 dB SNR for algorithm Model-based SB RTE [3]
3.5.6 Babble noise at $-1$ dB

Figure 34: Frequency-dependent $T_{60}$ estimation error in babble noise at $-1$ dB SNR for algorithm Model-based SB RTE [3]

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3.5.7 Fan noise at 18 dB

Figure 35: Frequency-dependent $T_{60}$ estimation error in fan noise at 18 dB SNR for algorithm Model-based SB RTE [3]
3.5.8 Fan noise at 12 dB

Figure 36: Frequency-dependent $T_{60}$ estimation error in fan noise at 12 dB SNR for algorithm Model-based SB RTE [3]
3.5.9 Fan noise at $-1$ dB

Figure 37: Frequency-dependent $T_{60}$ estimation error in fan noise at $-1$ dB SNR for algorithm Model-based SB RTE [3]
4 DRR estimation results

4.1 Fullband DRR estimation results by noise type

4.1.1 Ambient noise
Figure 38: Fullband DRR estimation error in ambient noise for all SNRs
| Ref. | Algorithm                                                                 | Class   | Mic. Config. | Bias | MSE  | ρ    | RTF |
|------|--------------------------------------------------------------------------|---------|--------------|------|------|------|-----|
| f    | PSD est. in beamspace, bias comp. [21]                                   | ABC     | Mobile       | 1.21 | 8.32 | 0.583 | 0.757 |
| g    | PSD est. in beamspace (Raw) [21]                                         | ABC     | Mobile       | -5.76 | 40   | 0.583 | 3.15 |
| h    | PSD est. in beamspace v2 [21]                                            | ABC     | Mobile       | -5.46 | 40.1 | 0.393 | 0.844 |
| i    | PSD est. by twin BF [22]                                                 | ABC     | Mobile       | -5.34 | 39.9 | 0.351 | 0.614 |
| j    | Spatial Covariance in matrix mode [23]                                   | ABC     | Mobile       | -5.17 | 65   | 0.2   | 0.627 |
| k    | NIRAv2 [7]                                                               | MLMF    | Single       | -1.68 | 14   | 0.568 | 0.897 |
| l    | NIRAv3 [7]                                                               | MLMF    | Single       | -1.8  | 15   | 0.536 | 0.897 |
| m    | NIRAv1 [7]                                                               | MLMF    | Single       | -3.65 | 13.6 | 0.32  | 0.897 |
| n    | Particle velocity [4]                                                   | ABC     | EM32         | -1.85 | 6.62 | 0.559 | 0.134 |
| o    | Multi-layer perceptron [14]                                               | MLMF    | Single       | -1.12 | 16.2 | 0.409 | 0.0578 |
| p    | Multi-layer perceptron P2 [14]                                           | MLMF    | Chromebook   | -2.38 | 14.6 | 0.231 | 0.0589 |
| q    | Multi-layer perceptron P2 [14]                                           | MLMF    | Mobile       | -1.36 | 13.6 | 0.42  | 0.0557 |
| r    | Multi-layer perceptron P2 [14]                                           | MLMF    | Crucif       | -1.33 | 14.6 | 0.555 | 0.0569 |
| s    | Multi-layer perceptron P2 [14]                                           | MLMF    | Lin8Ch       | -3.57 | 24.7 | 0.34  | 0.062 |
| t    | Multi-layer perceptron P2 [14]                                           | MLMF    | EM32         | -2.02 | 13.7 | 0.32  | 0.0578 |
| u    | Multi-layer perceptron P2 [14]                                           | MLMF    | Chromebook   | -5.78 | 46.8 | 0.272 | 0.0323 |
| v    | DENBE no noise reduction [24]                                            | ABC     | Chromebook   | -3.53 | 25.5 | 0.337 | 0.0602 |
| w    | DENBE spectral subtraction [5]                                           | ABC     | Chromebook   | -3.24 | 24.5 | 0.321 | 0.0474 |
| x    | DENBE spec. sub. Gerkmann [24]                                           | ABC     | Chromebook   | -3.24 | 24.5 | 0.321 | 0.775 |
| y    | DENBE filtered subbands [5]                                              | ABC     | Chromebook   | -3.24 | 24.5 | 0.321 | 0.0449 |
| z    | DENBE FFT derived subbands [5]                                           | ABC     | Chromebook   | -3.24 | 24.5 | 0.321 | 0.0449 |
| o    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Chromebook   | -4.75 | 29.5 | 0.276 | 1.04  |
| p    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Chromebook   | -3.23 | 15.6 | 0.298 | 0.831 |
| q    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Mobile       | -3.96 | 25.9 | 0.233 | 1.59  |
| r    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Mobile       | -2.78 | 17.7 | 0.215 | 1.26  |
| s    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Crucif       | -3.55 | 25.3 | 0.171 | 2.63  |
| t    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Crucif       | -2.39 | 18   | 0.169 | 2.09  |
| u    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Single       | -4.19 | 34.2 | -0.168 | 0.543 |
| v    | OSRMR Sec. 2.2. [15]                                                    | SFM     | Single       | -4.28 | 34.9 | -0.185 | 0.446 |
| w    | Per acoust. band SKRM Sec. 2.5. [15]                                     | SFM     | Single       | -0.0744 | 22.1 | 0.0317 | 0.58 |
| x    | Temporal dynamics [23]                                                  | SFM     | Single       | -11.2 | 142  | 0.185 | 0.0819 |
| y    | QA Reverb [11]                                                           | SFM     | Single       | 2.41  | 23   | 0.0583 | 0.391 |
| z    | Blind est. of coherent-to-diffuse energy ratio [9]                       | ABC     | Chromebook   | -11.4 | 146  | 0.266 | 0.019 |

Table 21: DRR estimation algorithm performance in ambient noise for all SNRs
4.1.2 Babble noise

Figure 39: Fullband DRR estimation error in babble noise for all SNRs
### Table 22: DRR estimation algorithm performance in babble noise for all SNRs

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE  | ρ | RTF  |
|------|-----------|-------|--------------|------|------|---|------|
| 1    | PSD est. in beamspace, bias comp. [21] | ABC   | Mobile       | 0.839 | 8.2  | 0.555 | 0.757  |
| 2    | PSD est. in beamspace (Raw) [21]     | ABC   | Mobile       | -6.13 | 45   | 0.555 | 3.17   |
| h    | PSD est. in beamspace v2 [21]        | ABC   | Mobile       | -6.1   | 48.4 | 0.42  | 0.843  |
| i    | PSD est. by twin BF [22]             | ABC   | Mobile       | -6.38  | 54.6 | 0.358 | 0.615  |
| j    | Spatial Covariance in matrix mode [23]| ABC   | Mobile       | -5.6   | 57   | 0.29  | 0.627  |
| k    | NIRAv2 [7]                           | MLMF  | Single       | -1.66  | 13.2 | 0.61  | 0.906  |
| l    | NIRAv3 [7]                           | MLMF  | Single       | -1.17  | 12.7 | 0.57  | 0.906  |
| m    | NIRAv1 [7]                           | MLMF  | Single       | -1.14  | 12.6 | 0.571 | 0.906  |
| n    | Particle velocity [4]                | ABC   | EM32         | -3.13  | 16.2 | 0.356 | 0.134  |
| o    | Multi-layer perceptron [14]          | MLMF  | Single       | -1.53  | 15.7 | 0.455 | 0.0579 |
| p    | Multi-layer perceptron P2 [14]       | MLMF  | Single       | -1.95  | 17   | 0.528 | 0.0579 |
| q    | Multi-layer perceptron P2 [14]       | MLMF  | Chromebook   | -2.31  | 13   | 0.328 | 0.0888 |
| r    | Multi-layer perceptron P2 [14]       | MLMF  | Mobile       | -2.25  | 17.3 | 0.386 | 0.0555 |
| s    | Multi-layer perceptron P2 [14]       | MLMF  | Crucif       | -1.93  | 17.2 | 0.506 | 0.057  |
| t    | Multi-layer perceptron P2 [14]       | MLMF  | Lin8Ch       | -3.75  | 28.4 | 0.185 | 0.0618 |
| u    | Multi-layer perceptron P2 [14]       | MLMF  | EM32         | -2.6   | 16.4 | 0.329 | 0.0576 |
| v    | DENBE no noise reduction [24]        | ABC   | Chromebook   | -6.59  | 59.3 | 0.24  | 0.0323 |
| w    | DENBE spectral subtraction [5]       | ABC   | Chromebook   | -5.74  | 50   | 0.237 | 0.0577 |
| x    | DENBE spec. sub. Gerkmann [24]       | ABC   | Chromebook   | -5.5   | 47.6 | 0.232 | 0.0476 |
| y    | DENBE filtered subbands [5]          | ABC   | Chromebook   | -5.5   | 47.6 | 0.232 | 0.0778 |
| z    | DENBE FFT derived subbands [5]       | ABC   | Chromebook   | -5.5   | 47.6 | 0.232 | 0.0448 |
| 0    | NOSRMR Sec. 2.2. [15]                | SFM   | Chromebook   | -4.72  | 27.7 | 0.315 | 1.04   |
| 1    | OSRMR Sec. 2.2. [15]                 | SFM   | Chromebook   | -3.68  | 19.5 | 0.257 | 0.833  |
| 2    | NOSRMR Sec. 2.2. [15]                | SFM   | Mobile       | -4.71  | 35.3 | 0.0325 | 1.58   |
| 3    | OSRMR Sec. 2.2. [15]                 | SFM   | Mobile       | -3.73  | 27.2 | 0.0231 | 1.26   |
| 4    | NOSRMR Sec. 2.2. [15]                | SFM   | Crucif       | -4.29  | 34.6 | -0.0707 | 2.63   |
| 5    | OSRMR Sec. 2.2. [15]                 | SFM   | Crucif       | -3.31  | 27.1 | -0.0591 | 2.1    |
| 6    | NOSRMR Sec. 2.2. [15]                | SFM   | Single       | -4.14  | 33.6 | 0.0538 | 0.534  |
| 7    | OSRMR Sec. 2.2. [15]                 | SFM   | Single       | -4.21  | 34.2 | 0.0352 | 0.444  |
| 8    | Per acoust. band SRMR Sec. 2.5. [15]  | SFM   | Single       | -1.3   | 22.5 | -0.0786 | 0.579  |
| 9    | Temporal dynamics [23]               | SFM   | Single       | -11.6  | 152  | -0.0352 | 0.0823 |
| α    | QA Reverb [11]                       | SFM   | Single       | 2.79   | 25.5 | 0.00216 | 0.392  |
| β    | Blind est. of coherent-to-diffuse energy ratio [9] | ABC    | Chromebook   | -12.8  | 179  | 0.261  | 0.019  |
4.1.3 Fan noise

Figure 40: Fullband DRR estimation error in fan noise for all SNRs
Table 23: DRR estimation algorithm performance in fan noise for all SNRs

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE | ρ | RTF |
|------|-----------|-------|--------------|------|-----|---|-----|
| f    | PSD est. in beamspace, bias comp. | ABC   | Mobile       | 1.16 | 7.89 | 0.608 | 0.757 |
| g    | PSD est. in beamspace (Raw) | ABC   | Mobile       | -5.8 | 40.2 | 0.608 | 3.18 |
| h    | PSD est. in beamspace v2 | ABC   | Mobile       | -5.54 | 40.4 | 0.428 | 0.844 |
| i    | PSD est. by twin BF | ABC   | Mobile       | -5.42 | 40  | 0.4 | 0.613 |
| j    | Spatial Covariance in matrix mode | ABC   | Mobile       | -5.33 | 61.4 | 0.254 | 0.627 |
| k    | NIRA v2 | MLMF  | Single       | -2.23 | 17.2 | 0.511 | 0.895 |
| l    | NIRA v3 | MLMF  | Single       | -1.88 | 16.5 | 0.467 | 0.895 |
| m    | NIRA v1 | MLMF  | Single       | -1.93 | 16.9 | 0.455 | 0.895 |
| n    | Particle velocity | ABC   | EM32         | -2.15 | 8.28 | 0.515 | 0.134 |
| o    | Multi-layer perceptron | MLMF  | Single       | -0.773 | 15.9 | 0.363 | 0.0578 |
| p    | Multi-layer perceptron | MLMF  | Single       | -1.2 | 15.9 | 0.465 | 0.0578 |
| q    | Multi-layer perceptron | MLMF  | Chromebook   | -2.41 | 13.4 | 0.23 | 0.059 |
| r    | Multi-layer perceptron | MLMF  | Mobile       | -1.39 | 13.9 | 0.412 | 0.0555 |
| s    | Multi-layer perceptron | MLMF  | Crucif       | -1.24 | 16.3 | 0.451 | 0.0569 |
| t    | Multi-layer perceptron | MLMF  | Lin8Ch       | -3.62 | 24.2 | 0.41 | 0.0617 |
| u    | Multi-layer perceptron | MLMF  | EM32         | -2.04 | 13.9 | 0.33 | 0.0574 |
| v    | DENBE no noise reduction | ABC   | Chromebook   | -5.77 | 47.4 | 0.411 | 0.0322 |
| w    | DENBE spectral subtraction | ABC   | Chromebook   | -3.48 | 26.9 | 0.401 | 0.0588 |
| x    | DENBE spec. sub. Gerkmann | ABC   | Chromebook   | -3.27 | 26.4 | 0.386 | 0.048 |
| y    | DENBE filtered subbands | ABC   | Chromebook   | -3.27 | 26.4 | 0.386 | 0.774 |
| z    | DENBE FFT derived subbands | ABC   | Chromebook   | -3.27 | 26.4 | 0.386 | 0.0452 |
| 0    | NOSRMR Sec. 2.2. | SFM   | Chromebook   | -5.82 | 45.6 | 0.281 | 1.03 |
| 1    | OSRMR Sec. 2.2. | SFM   | Chromebook   | -4.21 | 26.8 | 0.275 | 0.824 |
| 2    | OSRMR Sec. 2.2. | SFM   | Mobile       | -4.74 | 34.9 | 0.199 | 1.58 |
| 3    | OSRMR Sec. 2.2. | SFM   | Mobile       | -3.33 | 21.8 | 0.193 | 1.26 |
| 4    | OSRMR Sec. 2.2. | SFM   | Crucif       | -4.3 | 33.2 | 0.155 | 2.61 |
| 5    | OSRMR Sec. 2.2. | SFM   | Crucif       | -2.93 | 21.6 | 0.158 | 2.08 |
| 6    | NOSRMR Sec. 2.2. | SFM   | Single       | -4.14 | 33.8 | -0.151 | 0.543 |
| 7    | OSRMR Sec. 2.2. | SFM   | Single       | -4.24 | 34.5 | -0.173 | 0.447 |
| 8    | Per acoust. band SRMR Sec. 2.5. | SFM   | Single       | -1.33 | 23.7 | 0.0307 | 0.576 |
| 9    | Temporal dynamics | ABC   | SFM          | -11.4 | 147 | 0.173 | 0.0818 |
| α    | QA Reverb | SFM   | Single       | -2.34 | 22.1 | 0.116 | 0.391 |
| β    | Blind est. of coherent-to-diffuse energy ratio | ABC   | Chromebook   | -12 | 160 | 0.391 | 0.019 |
4.2 Fullband DRR estimation results by noise type and SNR

4.2.1 Ambient noise at 18 dB SNR

Figure 41: Fullband DRR estimation error in ambient noise at 18 dB SNR
Table 24: DRR estimation algorithm performance in ambient noise at 18 dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE | ρ  | RTF |
|------|-----------|-------|--------------|------|-----|----|-----|
| f    | PSD est. in beamspace, bias comp. [21] | ABC Mobile | 1.14 | 7.81 | 0.632 | 0.757 |
| g    | PSD est. in beamspace (Raw) [21] | ABC Mobile | -5.82 | 40.4 | 0.632 | 3.15 |
| h    | PSD est. in beamspace v2 [21] | ABC Mobile | -5.37 | 40.7 | 0.413 | 0.844 |
| i    | PSD est. by twin BF [22] | ABC Mobile | -5.11 | 39.2 | 0.381 | 0.614 |
| j    | Spatial Covariance in matrix mode [23] | ABC Mobile | -5.22 | 53 | 0.389 | 0.642 |
| k    | NIRAv2 [7] | MLMF Single | -1.73 | 13.9 | 0.821 | 0.897 |
| l    | NIRAv3 [7] | MLMF Single | -1.81 | 14.6 | 0.561 | 0.897 |
| m    | NIRAv1 [7] | MLMF Single | -1.90 | 14.9 | 0.597 | 0.897 |
| n    | Particle velocity [4] | ABC EM32 | -1.44 | 4.89 | 0.613 | 0.134 |
| o    | Multi-layer perceptron [14] | MLMF Single | -1.14 | 15.4 | 0.48 | 0.0578 |
| p    | Multi-layer perceptron P2 [14] | MLMF Single | -1.29 | 14.3 | 0.567 | 0.0578 |
| q    | Multi-layer perceptron P2 [14] | MLMF Chromebook | -2.28 | 11.6 | 0.331 | 0.0589 |
| r    | Multi-layer perceptron P2 [14] | MLMF Mobile | -1.17 | 12.8 | 0.428 | 0.0557 |
| s    | Multi-layer perceptron P2 [14] | MLMF Crucif | -1.16 | 13.5 | 0.592 | 0.0569 |
| t    | Multi-layer perceptron P2 [14] | MLMF Lin8Ch | -3.37 | 21.1 | 0.428 | 0.062 |
| u    | Multi-layer perceptron P2 [14] | MLMF EM32 | -1.93 | 11.9 | 0.373 | 0.0578 |
| v    | DENBE no noise reduction [24] | ABC Chromebook | -3.51 | 21.4 | 0.437 | 0.0323 |
| w    | DENBE spectral subtraction [5] | ABC Chromebook | -1.91 | 14.2 | 0.42 | 0.0602 |
| x    | DENBE spec. sub. Gerkmann [24] | ABC Chromebook | -1.58 | 13.8 | 0.403 | 0.0474 |
| y    | DENBE filtered subbands [5] | ABC Chromebook | -1.58 | 13.8 | 0.403 | 0.775 |
| z    | DENBE FFT derived subbands [5] | ABC Chromebook | -1.58 | 13.8 | 0.403 | 0.0449 |
| 0    | NOSRMR Sec. 2.2. [15] | SFM Chromebook | -3.66 | 17.8 | 0.377 | 1.04 |
| 1    | OSRMR Sec. 2.2. [15] | SFM Chromebook | -2.51 | 10.7 | 0.382 | 0.831 |
| 2    | OSRMR Sec. 2.2. [15] | SFM Chromebook | -3.51 | 23.2 | 0.121 | 1.59 |
| 3    | OSRMR Sec. 2.2. [15] | SFM Mobile | -2.53 | 16.8 | 0.0908 | 1.26 |
| 4    | OSRMR Sec. 2.2. [15] | SFM Crucif | -3.16 | 23.3 | 0.0551 | 2.63 |
| 5    | OSRMR Sec. 2.2. [15] | SFM Crucif | -2.15 | 17.3 | 0.0185 | 2.09 |
| 6    | OSRMR Sec. 2.2. [15] | SFM Single | -4.22 | 34.3 | -0.0427 | 0.543 |
| 7    | OSRMR Sec. 2.2. [15] | SFM Single | -4.35 | 35 | -0.0515 | 0.446 |
| 8    | Per acoust. band SRMR Sec. 2.5. [15] | SFM Single | 0.511 | 24.1 | -0.0548 | 0.58 |
| 9    | Temporal dynamics [25] | SFM Single | -11.1 | 140 | 0.0515 | 0.0819 |
| α   | QA Reverb [11] | SFM Single | 2.41 | 23.5 | 0.0488 | 0.391 |
| β   | Blind est. of coherent-to-diffuse energy ratio [9] | ABC Chromebook | -9.71 | 109 | 0.337 | 0.019 |

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4.2.2 Ambient noise at 12 dB SNR

Figure 42: Fullband DRR estimation error in ambient noise at 12 dB SNR
Table 25: DRR estimation algorithm performance in ambient noise at 12 dB SNR

| Ref. | Algorithm                          | Class          | Mic. Config. | Bias  | MSE   | $\rho$ | RTF |
|------|------------------------------------|----------------|--------------|-------|-------|-------|-----|
| 1    | PSD est. in beamspace, bias comp.  | ABC            | Mobile       | 1.18  | 7.63  | 0.632 | 0.757 |
| 2    | PSD est. in beamspace (Raw)        | ABC            | Mobile       | -5.79 | 39.8  | 0.632 | 3.15 |
| 3    | PSD est. in beamspace v2           | ABC            | Mobile       | -5.38 | 39.2  | 0.419 | 0.844 |
| 4    | PSD est. by twin BF                | ABC            | Mobile       | -5.16 | 38.1  | 0.37  | 0.614 |
| 5    | Spatial Covariance in matrix mode  | ABC            | Mobile       | -5.11 | 52.6  | 0.251 | 0.627 |
| 6    | NIRAv2                             | MLMF           | Single       | -1.71 | 14.2  | 0.562 | 0.897 |
| 7    | NIRAv3                             | MLMF           | Single       | -1.82 | 14.9  | 0.543 | 0.897 |
| 8    | NIRAv1                             | MLMF           | Single       | -1.84 | 15.1  | 0.539 | 0.897 |
| 9    | Particle velocity                  | ABC            | EM32         | -1.64 | 5.2   | 0.632 | 0.134 |
| 10   | Multi-layer perceptron             | MLMF           | Single       | -1.06 | 15.2  | 0.46  | 0.0578 |
| 11   | Multi-layer perceptron P2          | MLMF           | Single       | -1.33 | 15    | 0.545 | 0.0578 |
| 12   | Multi-layer perceptron P2 P2       | MLMF           | Chromebook   | -2.27 | 12.2  | 0.279 | 0.0589 |
| 13   | Multi-layer perceptron P2 P2       | MLMF           | Mobile       | -1.1  | 12.8  | 0.426 | 0.0557 |
| 14   | Multi-layer perceptron P2 P2       | MLMF           | Crucif       | -1.15 | 13.2  | 0.592 | 0.0569 |
| 15   | Multi-layer perceptron P2 P2       | MLMF           | Lin8Ch       | -3.37 | 21.5  | 0.435 | 0.062 |
| 16   | Multi-layer perceptron P2 P2       | MLMF           | EM32         | -1.88 | 11.8  | 0.386 | 0.0578 |
| 17   | DENBE no noise reduction           | ABC            | Chromebook   | -4.96 | 33.2  | 0.404 | 0.0323 |
| 18   | DENBE spectral subtraction         | ABC            | Chromebook   | -2.68 | 16.6  | 0.42  | 0.0602 |
| 19   | DENBE spec. sub. Gerkmann         | ABC            | Chromebook   | -2.28 | 15.2  | 0.399 | 0.0474 |
| 20   | DENBE filtered subbands           | ABC            | Chromebook   | -2.28 | 15.2  | 0.399 | 0.775 |
| 21   | DENBE FFT derived subbands        | ABC            | Chromebook   | -2.28 | 15.2  | 0.399 | 0.0449 |
| 22   | NOSRMR Sec. 2.2.                   | SFM            | Chromebook   | -3.83 | 19    | 0.392 | 1.04  |
| 23   | NOSRMR Sec. 2.2.                   | SFM            | Chromebook   | -2.62 | 11.2  | 0.41  | 0.831 |
| 24   | NOSRMR Sec. 2.2.                   | SFM            | Mobile       | -3.6  | 23.4  | 0.15  | 1.59  |
| 25   | NOSRMR Sec. 2.2.                   | SFM            | Mobile       | -2.56 | 16.9  | 0.116 | 1.26  |
| 26   | NOSRMR Sec. 2.2.                   | SFM            | Crucif       | -3.22 | 23.5  | 0.0688 | 2.63 |
| 27   | NOSRMR Sec. 2.2.                   | SFM            | Crucif       | -2.18 | 17.3  | 0.0496 | 2.09 |
| 28   | NOSRMR Sec. 2.2.                   | SFM            | Single       | -4.22 | 34.3  | -0.0748 | 0.543 |
| 29   | NOSRMR Sec. 2.2.                   | SFM            | Single       | -4.29 | 35    | -0.0777 | 0.446 |
| 30   | Per acoust. band SRMR Sec. 2.5.    | SFM            | Single       | 0.283 | 22.8  | -0.0139 | 0.58 |
| 31   | Temporal dynamics                  | SFM            | Single       | -11.1 | 140   | 0.0777 | 0.0819 |
| 32   | QA Reverb                          | SFM            | Single       | 2.37  | 23.5  | 0.0171 | 0.391 |
| 33   | Blind est. of coherent-to-diffuse energy ratio | ABC | Chromebook | -10.9 | 131   | 0.327 | 0.019 |
4.2.3 Ambient noise at $-1$ dB SNR

Figure 43: Fullband DRR estimation error in ambient noise at $-1$ dB SNR
Table 26: DRR estimation algorithm performance in ambient noise at $-1$ dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias | MSE   | $\rho$ | RTF |
|------|-----------|-------|--------------|------|-------|-------|-----|
| f    | PSD est. in beamspace, bias comp. [21] | ABC   | Mobile       | 1.3  | 9.51  | 0.578 | 0.757 |
| g    | PSD est. in beamspace (Raw) [21] | ABC   | Mobile       | -5.67| 39.9  | 0.578 | 3.15 |
| h    | PSD est. in beamspace v2 [21] | ABC   | Mobile       | -5.63| 40.2  | 0.431 | 0.844 |
| i    | PSD est. by twin BF [23] | ABC   | Mobile       | -5.76| 42.4  | 0.344 | 0.614 |
| j    | Spatial Covariance in matrix mode [23] | ABC   | Mobile       | -5.17| 89.4  | 0.0787| 0.627 |
| k    | NIRAv2 [7] | MLMF  | Single       | -1.6 | 13.9  | 0.561 | 0.897 |
| l    | NIRAv3 [7] | MLMF  | Single       | -1.78| 15.5  | 0.503 | 0.897 |
| m    | NIRAv1 [7] | MLMF  | Single       | -1.86| 16.1  | 0.488 | 0.897 |
| n    | Particle velocity [4] | ABC   | EM32         | -2.48| 9.77  | 0.479 | 0.134 |
| o    | Multi-layer perceptron [14] | MLMF  | Single       | -1.15| 17.9  | 0.253 | 0.0578 |
| p    | Multi-layer perceptron P2 [14] | MLMF  | Single       | -1.63| 17    | 0.486 | 0.0578 |
| q    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook   | -3.17| 20    | 0.116 | 0.0589 |
| r    | Multi-layer perceptron P2 [14] | MLMF  | Mobile       | -1.81| 15.2  | 0.412 | 0.0557 |
| s    | Multi-layer perceptron P2 [14] | MLMF  | Crucif       | -1.66| 17.1  | 0.481 | 0.0569 |
| t    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch       | -3.97| 31.4  | 0.178 | 0.0622 |
| u    | Multi-layer perceptron P2 [14] | MLMF  | EM32         | -2.23| 17.4  | 0.223 | 0.0578 |
| v    | DENBE no noise reduction [24] | ABC   | Chromebook   | -8.85| 85.7  | 0.152 | 0.0323 |
| w    | DENBE spectral subtraction [5] | ABC   | Chromebook   | -5.99| 45.8  | 0.308 | 0.0602 |
| x    | DENBE spec. sub. Gerkmann [24] | ABC   | Chromebook   | -5.88| 44.5  | 0.302 | 0.0474 |
| y    | DENBE filtered subbands [5] | ABC   | Chromebook   | -5.88| 44.5  | 0.302 | 0.775 |
| z    | DENBE FFT derived subbands [5] | ABC   | Chromebook   | -5.88| 44.5  | 0.302 | 0.0449 |
| 0    | NOSRMR Sec. 2.2. [15] | SFM   | Chromebook   | -6.77| 51.5  | 0.411 | 1.04 |
| 1    | NOSRMR Sec. 2.2. [15] | SFM   | Chromebook   | -4.55| 24.8  | 0.479 | 0.831 |
| 2    | NOSRMR Sec. 2.2. [15] | SFM   | Mobile       | -4.74| 31    | 0.423 | 1.59 |
| 3    | NOSRMR Sec. 2.2. [15] | SFM   | Mobile       | -3.26| 19.3  | 0.422 | 1.26 |
| 4    | NOSRMR Sec. 2.2. [15] | SFM   | Crucif       | -4.28| 29.2  | 0.374 | 2.63 |
| 5    | NOSRMR Sec. 2.2. [15] | SFM   | Crucif       | -2.84| 19    | 0.389 | 2.09 |
| 6    | NOSRMR Sec. 2.2. [15] | SFM   | Single       | -4.14| 34    | -0.335 | 0.543 |
| 7    | NOSRMR Sec. 2.2. [15] | SFM   | Single       | -4.25| 34.8  | -0.393 | 0.446 |
| 8    | Per acoust. band SRMR Sec. 2.5. [15] | SFM   | Single       | -1.02| 19.5  | 0.181 | 0.58 |
| 9    | Temporal dynamics [23] | SFM   | Single       | -11.4| 145   | 0.393 | 0.0819 |
| α    | QA Reverb [11] | SFM   | Single       | 2.43 | 22.2  | 0.137 | 0.391 |
| β    | Blind est. of coherent-to-diffuse energy ratio [9] | ABC   | Chromebook   | -13.8| 199   | 0.212 | 0.019 |

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4.2.4 Babble noise at 18 dB SNR

Figure 44: Fullband DRR estimation error in babble noise at 18 dB SNR
Table 27: DRR estimation algorithm performance in babble noise at 18 dB SNR

| Ref. | Algorithm                                      | Class | Mic. Config. | Bias  | MSE     | ρ  | RTF |
|------|-----------------------------------------------|-------|--------------|-------|---------|----|-----|
| f    | PSD est. in beamspace, bias comp. [21]        | ABC   | Mobile       | 1.12  | 7.96    | 0.631 | 0.757 |
| g    | PSD est. in beamspace (Raw) [21]              | ABC   | Mobile       | -5.85 | 40.9    | 0.629 | 3.17 |
| h    | PSD est. in beamspace v2 [21]                 | ABC   | Mobile       | -5.38 | 41.2    | 0.422 | 0.843 |
| i    | PSD est. by twin BF [21]                      | ABC   | Mobile       | -5.13 | 40      | 0.382 | 0.615 |
| j    | Spatial Covariance in matrix mode [23]        | ABC   | Mobile       | -5.09 | 51.7    | 0.312 | 0.627 |
| k    | NIRAv2 [7]                                    | MLMF  | Single       | -1.67 | 12.8    | 0.633 | 0.906 |
| l    | NIRAv3 [7]                                    | MLMF  | Single       | -1.35 | 13      | 0.576 | 0.906 |
| m    | NIRAv1 [7]                                    | MLMF  | Single       | -1.35 | 12.9    | 0.579 | 0.906 |
| n    | Particle velocity [4]                         | ABC   | EM32         | -1.62 | 5.28    | 0.623 | 0.134 |
| o    | Multi-layer perceptron [14]                   | MLMF  | Single       | -1.54 | 15.5    | 0.485 | 0.0579 |
| p    | Multi-layer perceptron P2 [14]                | MLMF  | Mobile       | -1.6  | 14.1    | 0.586 | 0.0579 |
| q    | Multi-layer perceptron P2 [14]                | MLMF  | Chromebook   | -2.16 | 11.1    | 0.363 | 0.0588 |
| r    | Multi-layer perceptron P2 [14]                | MLMF  | Crucif       | -1.76 | 13.8    | 0.434 | 0.0555 |
| s    | Multi-layer perceptron P2 [14]                | MLMF  | Lin8Ch       | -1.62 | 14.6    | 0.557 | 0.057 |
| t    | Multi-layer perceptron P2 [14]                | MLMF  | EM32         | -3.56 | 23.3    | 0.368 | 0.0618 |
| u    | Multi-layer perceptron P2 [14]                | MLMF  | EM32         | -2.2  | 13.5    | 0.369 | 0.0576 |
| v    | DENBE no noise reduction [24]                 | ABC   | Chromebook   | -4.11 | 27.4    | 0.406 | 0.0323 |
| w    | DENBE spectral subtraction [5]                | ABC   | Chromebook   | -3.27 | 22      | 0.393 | 0.0577 |
| x    | DENBE spec. sub. Gerkmann [24]                | ABC   | Chromebook   | -3.02 | 20.6    | 0.385 | 0.0476 |
| y    | DENBE filtered subbands [5]                   | ABC   | Chromebook   | -3.02 | 20.6    | 0.385 | 0.778 |
| z    | DENBE FFT derived subbands [5]                | ABC   | Chromebook   | -3.02 | 20.6    | 0.385 | 0.0448 |
| 0    | NOSRMR Sec. 2.2. [15]                        | SFM   | Chromebook   | -3.76 | 18.5    | 0.373 | 1.04 |
| 1    | NOSRMR Sec. 2.2. [15]                        | SFM   | Chromebook   | -2.6  | 11.1    | 0.384 | 0.833 |
| 2    | NOSRMR Sec. 2.2. [15]                        | SFM   | Mobile       | -3.66 | 24.2    | 0.106 | 1.58 |
| 3    | NOSRMR Sec. 2.2. [15]                        | SFM   | Mobile       | -2.62 | 17.4    | 0.0805 | 1.26 |
| 4    | NOSRMR Sec. 2.2. [15]                        | SFM   | Crucif       | -3.28 | 24.3    | 0.0103 | 2.63 |
| 5    | NOSRMR Sec. 2.2. [15]                        | SFM   | Crucif       | -2.24 | 18      | -0.00234 | 2.7 |
| 6    | NOSRMR Sec. 2.2. [15]                        | SFM   | Single       | -4.21 | 34.3    | -0.0213 | 0.534 |
| 7    | NOSRMR Sec. 2.2. [15]                        | SFM   | Single       | -4.29 | 34.9    | -0.0334 | 0.444 |
| 8    | Per acoust. band SRMR Sec. 2.5. [15]          | SFM   | Single       | -0.337 | 21.5    | -0.0605 | 0.579 |
| 9    | Temporal dynamics [25]                       | SFM   | Single       | -11.1 | 141     | 0.0354 | 0.0823 |
| α    | QA Reverb [11]                               | SFM   | Single       | 2.63  | 24.8    | 0.0256 | 0.392 |
| β    | Blind est. of coherent-to-diffuse energy ratio [9] | ABC | Chromebook | -10.8 | 133    | 0.329 | 0.019 |

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4.2.5 Babble noise at 12 dB SNR

Figure 45: Fullband DRR estimation error in babble noise at 12 dB SNR
Table 28: DRR estimation algorithm performance in babble noise at 12 dB SNR

| Ref. | Algorithm Description | Class | Mic. Config. | Bias | MSE | \( \rho \) | RTF |
|------|-----------------------|-------|-------------|------|-----|-------|-----|
| f    | PSD est. in beamspace, bias comp. [24] | ABC | Mobile | 1.11 | 7.41 | 0.651 | 0.757 |
| g    | PSD est. in beamspace (Raw) [24] | ABC | Mobile | -2.86 | 40.5 | 0.651 | 3.17 |
| h    | PSD est. in beamspace v2 [24] | ABC | Mobile | -3.49 | 40.9 | 0.434 | 0.843 |
| i    | PSD est. by twin BF [24] | ABC | Mobile | -5.4 | 40.8 | 0.416 | 0.615 |
| j    | Spatial Covariance in matrix mode [24] | ABC | Mobile | -5.2 | 48.4 | 0.342 | 0.627 |
| k    | NIRAv2 [7] | MLMF | Single | -1.73 | 13.7 | 0.596 | 0.906 |
| l    | NIRAv3 [7] | MLMF | Single | -1.26 | 13 | 0.561 | 0.906 |
| m    | NIRAv1 [7] | MLMF | Single | -1.23 | 12.9 | 0.564 | 0.906 |
| n    | Particle velocity [4] | ABC | EM32 | -2.15 | 7.25 | 0.604 | 0.134 |
| o    | Multi-layer perceptron [14] | MLMF | Single | -1.57 | 15.4 | 0.483 | 0.0579 |
| p    | Multi-layer perceptron P2 [14] | MLMF | Single | -1.8 | 15.5 | 0.558 | 0.0579 |
| q    | Multi-layer perceptron P2 [14] | MLMF | Chromebook | -2.11 | 11.3 | 0.349 | 0.0588 |
| r    | Multi-layer perceptron P2 [14] | MLMF | Mobile | -2.01 | 15.6 | 0.416 | 0.0555 |
| s    | Multi-layer perceptron P2 [14] | MLMF | Crucif | -1.64 | 14.8 | 0.551 | 0.057 |
| t    | Multi-layer perceptron P2 [14] | MLMF | Lin8Ch | -3.64 | 25.8 | 0.246 | 0.0618 |
| u    | Multi-layer perceptron P2 [14] | MLMF | EM32 | -2.51 | 14.1 | 0.413 | 0.0576 |
| v    | DENBE no noise reduction [24] | ABC | Chromebook | -5.91 | 46 | 0.331 | 0.0323 |
| w    | DENBE spectral subtraction [5] | ABC | Chromebook | -4.9 | 35.7 | 0.325 | 0.0577 |
| x    | DENBE spec. sub. Gerkmann [24] | ABC | Chromebook | -4.62 | 33 | 0.324 | 0.0476 |
| y    | DENBE filtered subbands [5] | ABC | Chromebook | -4.62 | 33 | 0.324 | 0.778 |
| z    | DENBE FFT derived subbands [5] | ABC | Chromebook | -4.62 | 33 | 0.324 | 0.0448 |
| 0    | OSRMR Sec. 2.2. [15] | SFM | Chromebook | -4.09 | 21.1 | 0.388 | 1.04 |
| 1    | OSRMR Sec. 2.2. [15] | SFM | Chromebook | -2.88 | 12.6 | 0.411 | 0.833 |
| 2    | OSRMR Sec. 2.2. [15] | SFM | Mobile | -4 | 27 | 0.0937 | 1.58 |
| 3    | OSRMR Sec. 2.2. [15] | SFM | Mobile | -2.88 | 18.8 | 0.0782 | 1.26 |
| 4    | OSRMR Sec. 2.2. [15] | SFM | Crucif | -3.59 | 26.7 | -0.014 | 2.63 |
| 5    | OSRMR Sec. 2.2. [15] | SFM | Crucif | -2.49 | 19.3 | -0.0169 | 2.1 |
| 6    | OSRMR Sec. 2.2. [15] | SFM | Single | -4.19 | 34 | -0.000435 | 0.534 |
| 7    | OSRMR Sec. 2.2. [15] | SFM | Single | -4.27 | 34.8 | -0.0218 | 0.444 |
| 8    | Per acoust. band SRMR Sec. 2.5. [15] | SFM | Single | -1.12 | 21.2 | -0.0696 | 0.579 |
| 9    | Temporal dynamics [24] | SFM | Single | -11.2 | 143 | 0.0218 | 0.0823 |
| α    | QA Reverb [11] | SFM | Single | 2.8 | 25.5 | 0.0333 | 0.392 |

β Blind est. of coherent-to-diffuse energy ratio [9] ABC Chromebook -12.2 163 0.31 0.019
4.2.6 Babble noise at $-1$ dB SNR

Figure 46: Fullband DRR estimation error in babble noise at $-1$ dB SNR
Table 29: DRR estimation algorithm performance in babble noise at \(-1\) dB SNR

| Ref. | Algorithm | Class | Mic. Config. | Bias  | MSE   | \(\rho\) | RTF |
|------|-----------|-------|--------------|-------|-------|---------|-----|
| f    | PSD est. in beamspace, bias comp. [21] | ABC   | Mobile       | 0.289 | 9.23  | 0.362   | 0.757 |
| g    | PSD est. in beamspace (Raw) [21] | ABC   | Mobile       | -6.67 | 53.7  | 0.362   | 3.17 |
| h    | PSD est. in beamspace v2 [21] | ABC   | Mobile       | -7.42 | 63.1  | 0.496   | 0.843 |
| i    | PSD est. by twin BF [22] | ABC   | Mobile       | -6.61 | 83.1  | 0.447   | 0.615 |
| j    | Spatial Covariance in matrix mode [23] | ABC   | Mobile       | -6.51 | 71.2  | 0.23    | 0.627 |
| k    | NIRAv2 [7] | MLMF  | Single       | -1.58 | 13.1  | 0.601   | 0.906 |
| l    | NIRAv3 [7] | MLMF  | Single       | -0.885| 12.1  | 0.594   | 0.906 |
| m    | NIRAv1 [7] | MLMF  | Single       | -0.848| 12.1  | 0.595   | 0.906 |
| n    | Particle velocity [4] | ABC   | EM32         | -5.63 | 36.2  | 0.259   | 0.134 |
| o    | Multi-layer perceptron [14] | MLMF  | Single       | -1.46 | 16.1  | 0.395   | 0.0579 |
| p    | Multi-layer perceptron P2 [14] | MLMF  | Single       | -2.45 | 21.5  | 0.454   | 0.0579 |
| q    | Multi-layer perceptron P2 [14] | MLMF  | Chromebook   | -2.66 | 16.5  | 0.293   | 0.0588 |
| r    | Multi-layer perceptron P2 [14] | MLMF  | Mobile       | -2.99 | 22.6  | 0.331   | 0.0555 |
| s    | Multi-layer perceptron P2 [14] | MLMF  | Crucif       | -2.54 | 22.2  | 0.434   | 0.057 |
| t    | Multi-layer perceptron P2 [14] | MLMF  | Lin8Ch       | -4.04 | 36    | -0.0201 | 0.0618 |
| u    | Multi-layer perceptron P2 [14] | MLMF  | EM32         | -3.07 | 21.5  | 0.23    | 0.0576 |
| v    | DENBE no noise reduction [24] | ABC   | Chromebook   | -9.74 | 105   | 0.124   | 0.0323 |
| w    | DENBE spectral subtraction [5] | ABC   | Chromebook   | -9.03 | 92.2  | 0.142   | 0.0577 |
| x    | DENBE spec. sub. Gerkmann [24] | ABC   | Chromebook   | -8.87 | 89.1  | 0.137   | 0.0476 |
| y    | DENBE filtered subbands [5] | ABC   | Chromebook   | -8.87 | 89.1  | 0.137   | 0.778 |
| z    | DENBE FFT derived subbands [5] | ABC   | Chromebook   | -8.87 | 89.1  | 0.137   | 0.0448 |
| 0    | NOSRMR Sec. 2.2. [15] | SFM   | Chromebook   | -6.33 | 43.6  | 0.351   | 1.04 |
| 1    | NOSRMR Sec. 2.2. [15] | SFM   | Chromebook   | -3.57 | 34.7  | 0.539   | 0.833 |
| 2    | NOSRMR Sec. 2.2. [15] | SFM   | Mobile       | -6.47 | 54.7  | -0.0348 | 1.58 |
| 3    | NOSRMR Sec. 2.2. [15] | SFM   | Mobile       | -5.69 | 45.5  | 0.00456 | 1.26 |
| 4    | NOSRMR Sec. 2.2. [15] | SFM   | Crucif       | -3.99 | 52.9  | -0.253  | 2.63 |
| 5    | NOSRMR Sec. 2.2. [15] | SFM   | Crucif       | -5.21 | 44.1  | -0.19   | 2.1 |
| 6    | NOSRMR Sec. 2.2. [15] | SFM   | Single       | -4.02 | 32.5  | 0.197   | 0.334 |
| 7    | NOSRMR Sec. 2.2. [15] | SFM   | Single       | -4.07 | 32.9  | 0.136   | 0.444 |
| 8    | Per acoust. band SRMR Sec. 2.5. [15] | SFM   | Single       | -2.45 | 24.9  | -0.201  | 0.579 |
| 9    | Temporal dynamics [23] | SFM   | Single       | -12.4 | 172   | -0.136  | 0.0823 |
| α    | QA Reverb [11] | SFM   | Single       | 2.96  | 26.3  | -0.0876 | 0.392 |
| β    | Blind est. of coherent-to-diffuse energy ratio [9] | ABC   | Chromebook   | -15.3 | 241   | 0.244   | 0.019 |

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4.2.7 Fan noise at 18 dB SNR

Figure 47: Fullband DRR estimation error in fan noise at 18 dB SNR
Table 30: DRR estimation algorithm performance in fan noise at 18 dB SNR

| Ref. | Algorithm                                      | Class | Mic. Config. | Bias  | MSE  | ρ   | RTF |
|------|-----------------------------------------------|-------|--------------|-------|------|-----|-----|
| f    | PSD est. in beamspace, bias comp. [21]  | ABC   | Mobile       | 1.13  | 7.67 | 0.638 | 0.757 |
| g    | PSD est. in beamspace (Raw) [21]              | ABC   | Mobile       | -5.83 | 40.4 | 0.639 | 3.18  |
| h    | PSD est. in beamspace v2 [21]                | ABC   | Mobile       | -5.38 | 40.9 | 0.416 | 0.844 |
| i    | PSD est. by twin BF [22]                     | ABC   | Mobile       | -5.09 | 39.4 | 0.378 | 0.613 |
| j    | Spatial Covariance in matrix mode [23]       | ABC   | Mobile       | -5.18 | 52.6 | 0.301 | 0.627 |
| k    | NIRAv2 [7]                                    | MLMF  | Single       | -1.97 | 14.8 | 0.583 | 0.895 |
| l    | NIRAv3 [7]                                    | MLMF  | Single       | -1.85 | 15.1 | 0.537 | 0.895 |
| m    | NIRAv1 [7]                                    | MLMF  | Single       | -1.86 | 15.3 | 0.531 | 0.895 |
| n    | Particle velocity [4]                         | ABC   | EM32         | -1.45 | 4.9  | 0.624 | 0.134 |
| o    | Multi-layer perceptron [14]                   | MLMF  | Single       | -0.829| 14.4 | 0.476 | 0.0578^t |
| p    | Multi-layer perceptron P2 [14]                | MLMF  | Single       | -0.883| 14.3 | 0.512 | 0.0578^t |
| q    | Multi-layer perceptron P2 [14]                | MLMF  | Chromebook   | -2.09 | 10.8 | 0.306 | 0.059^t |
| r    | Multi-layer perceptron P2 [14]                | MLMF  | Mobile       | -0.997| 11.7 | 0.472 | 0.0555^t |
| s    | Multi-layer perceptron P2 [14]                | MLMF  | Crucif       | -0.985| 14.3 | 0.526 | 0.0569^t |
| t    | Multi-layer perceptron P2 [14]                | MLMF  | Lin8Ch       | -3.19 | 19.3 | 0.514 | 0.0617^t |
| u    | Multi-layer perceptron P2 [14]                | MLMF  | EM32         | -1.61 | 11.2 | 0.403 | 0.0574^t |
| v    | DENBE no noise reduction [24]                 | ABC   | Chromebook   | -3.49 | 22.8 | 0.497 | 0.0322 |
| w    | DENBE spectral subtraction [5]                | ABC   | Chromebook   | -1.83 | 15.5 | 0.439 | 0.0588 |
| x    | DENBE spec. sub. Gerkmann [24]               | ABC   | Chromebook   | -1.55 | 15.2 | 0.418 | 0.048  |
| y    | DENBE filtered subbands [5]                  | ABC   | Chromebook   | -1.55 | 15.2 | 0.418 | 0.774  |
| z    | DENBE FFT derived subbands [5]               | ABC   | Chromebook   | -1.55 | 15.2 | 0.418 | 0.0452 |
| 0    | NOSRMR Sec. 2.2. [15]                        | SFM   | Chromebook   | -3.72 | 18.2 | 0.386 | 1.03   |
| 1    | OSRMR Sec. 2.2. [15]                         | SFM   | Chromebook   | -2.56 | 10.9 | 0.398 | 0.824  |
| 2    | NOSRMR Sec. 2.2. [15]                        | SFM   | Mobile       | -3.58 | 23.4 | 0.127 | 1.58   |
| 3    | OSRMR Sec. 2.2. [15]                         | SFM   | Mobile       | -2.55 | 16.9 | 0.0964| 1.26   |
| 4    | NOSRMR Sec. 2.2. [15]                        | SFM   | Crucif       | -3.2  | 23.5 | 0.0412| 2.61   |
| 5    | OSRMR Sec. 2.2. [15]                         | SFM   | Crucif       | -2.17 | 17.6 | 0.0264| 2.08   |
| 6    | NOSRMR Sec. 2.2. [15]                        | SFM   | Single       | -4.22 | 34.3 | -0.0485| 0.543 |
| 7    | OSRMR Sec. 2.2. [15]                         | SFM   | Single       | -4.3  | 35   | -0.0587| 0.447 |
| 8    | Per acoust. band SRMR Sec. 2.5. [15]         | SFM   | Single       | 0.136 | 22.2 | -0.0161| 0.576 |
| 9    | Temporal dynamics [25]                       | SFM   | Single       | -11.1 | 140 | 0.0587| 0.0818 |
| α    | QA Reverb [11]                               | SFM   | Single       | 2.39  | 22.9 | 0.086 | 0.391 |
| β    | Blind est. of coherent-to-diffuse energy ratio [9]| ABC | Chromebook | -10.2 | 120 | 0.419 | 0.019 |

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4.2.8 Fan noise at 12 dB SNR

Figure 48: Fullband DRR estimation error in fan noise at 12 dB SNR
Table 31: DRR estimation algorithm performance in fan noise at 12 dB SNR

| Ref. | Algorithm                                      | Class | Mic. Config. | Bias  | MSE    | ρ     | RTF  |
|------|-----------------------------------------------|-------|--------------|-------|--------|-------|------|
| f    | PSD est. in beamspace, bias comp. [21]        | ABC   | Mobile       | 1.15  | 7.15   | 0.662 | 0.757|
| g    | PSD est. in beamspace (Raw) [21]              | ABC   | Mobile       | -5.81 | 39.6   | 0.662 | 3.18 |
| h    | PSD est. in beamspace v3 [21]                 | ABC   | Mobile       | -5.48 | 39.7   | 0.464 | 0.844|
| i    | PSD est. by twin BF [22]                      | ABC   | Mobile       | -5.3  | 38.6   | 0.434 | 0.613|
| j    | Spatial Covariance in matrix mode [23]        | ABC   | Mobile       | -5.4  | 50.5   | 0.357 | 0.627|
| k    | NIRAv2 [7]                                    | MLMF  | Single       | -2.04 | 15.3   | 0.57  | 0.895|
| l    | NIRAv3 [7]                                    | MLMF  | Single       | -1.92 | 16.1   | 0.5   | 0.895|
| m    | NIRAv1 [7]                                    | MLMF  | Single       | -1.93 | 16.3   | 0.493 | 0.895|
| n    | Particle velocity [4]                         | ABC   | EM32         | -1.67 | 5.69   | 0.589 | 0.134|
| o    | Multi-layer perceptron [14]                   | MLMF  | Single       | -0.743| 14.4   | 0.449 | 0.0578 |
| p    | Multi-layer perceptron P2 [14]                | MLMF  | Single       | -0.941| 14.7   | 0.498 | 0.0578 |
| q    | Multi-layer perceptron P2 [14]                | MLMF  | Chromebook   | -2.06 | 10.1   | 0.288 | 0.059 |
| r    | Multi-layer perceptron P2 [14]                | MLMF  | Mobile       | -0.905| 11.7   | 0.476 | 0.0555 |
| s    | Multi-layer perceptron P2 [14]                | MLMF  | Crucif       | -0.893| 14     | 0.513 | 0.0569 |
| t    | Multi-layer perceptron P2 [14]                | MLMF  | Lin8Ch       | -3.22 | 20.5   | 0.456 | 0.0617 |
| u    | Multi-layer perceptron P2 [14]                | MLMF  | EM32         | -1.65 | 11.8   | 0.388 | 0.0574 |
| v    | DENBE no noise reduction [24]                 | ABC   | Chromebook   | -5.06 | 36.3   | 0.501 | 0.0322|
| w    | DENBE spectral subtraction [5]                | ABC   | Chromebook   | -2.58 | 17.6   | 0.455 | 0.0588 |
| x    | DENBE spec. sub. Gerkmann [24]                | ABC   | Chromebook   | -2.21 | 16.4   | 0.432 | 0.048 |
| y    | DENBE filtered subbands [5]                   | ABC   | Chromebook   | -2.21 | 16.4   | 0.432 | 0.774 |
| z    | DENBE FFT derived subbands [5]                | ABC   | Chromebook   | -2.21 | 16.4   | 0.432 | 0.0452|
| 0    | NOSRMR Sec. 2.2. [15]                         | SFM   | Chromebook   | -4.07 | 20.8   | 0.418 | 1.03 |
| 1    | OSRMR Sec. 2.2. [15]                          | SFM   | Chromebook   | -2.78 | 11.9   | 0.452 | 0.824 |
| 2    | NOSRMR Sec. 2.2. [15]                         | SFM   | Mobile       | -3.74 | 24.4   | 0.172 | 1.58 |
| 3    | OSRMR Sec. 2.2. [15]                          | SFM   | Mobile       | -2.65 | 17.3   | 0.137 | 1.26 |
| 4    | NOSRMR Sec. 2.2. [15]                         | SFM   | Crucif       | -3.36 | 24.3   | 0.09  | 2.61 |
| 5    | OSRMR Sec. 2.2. [15]                          | SFM   | Crucif       | -2.27 | 17.8   | 0.0731| 2.08 |
| 6    | NOSRMR Sec. 2.2. [15]                         | SFM   | Single       | -4.21 | 34.3   | -0.0954| 0.543|
| 7    | OSRMR Sec. 2.2. [15]                          | SFM   | Single       | -4.29 | 34.9   | -0.105| 0.447|
| 8    | Per acoust. band SRMR Sec. 2.5. [15]          | SFM   | Single       | -0.669| 20.3   | 0.0451| 0.576|
| 9    | Temporal dynamics [25]                        | SFM   | Single       | -11.2 | 141    | 0.105 | 0.0818|
| α    | QA Reverb [11]                                | SFM   | Single       | 2.41  | 22.7   | 0.104 | 0.391|
| β    | Blind est. of coherent-to-diffuse energy ratio [9] | ABC  | Chromebook   | -11.5 | 147    | 0.428 | 0.019|
4.2.9 Fan noise at $-1$ dB SNR

Figure 49: Fullband DRR estimation error in fan noise at $-1$ dB SNR
Table 32: DRR estimation algorithm performance in fan noise at −1 dB SNR

| Ref | Algorithm                                      | Class | Mic. Config. | Bias | MSE  | ρ    | RTF |
|-----|-----------------------------------------------|-------|--------------|------|------|------|-----|
| f   | PSD est. in beamspace, bias comp. [21] ABC    | Mobile| 1.2          | 8.85 | 0.609| 0.757|     |
| g   | PSD est. in beamspace (Raw) [21] ABC          | Mobile| -5.76        | 40.6 | 0.609| 3.18 |     |
| h   | PSD est. in beamspace v2 [21] ABC             | Mobile| -5.75        | 40.6 | 0.553| 0.844|     |
| i   | PSD est. by twin BF [23] ABC Mobile           | Mobile| -5.86        | 42.1 | 0.51 | 0.613|     |
| j   | Spatial Covariance in matrix mode [24] ABC    | Mobile| -5.4         | 81.2 | 0.161| 0.627|     |
| k   | NIRA v2 [7] MLMF Single ABC Mobile            |       | -2.67        | 21.5 | 0.384| 0.895|     |
| l   | NIRA v3 [7] MLMF Single ABC Mobile            |       | -1.89        | 18.3 | 0.354| 0.895|     |
| m   | NIRA v1 [7] MLMF Single ABC Mobile            |       | -1.98        | 19.1 | 0.33 | 0.895|     |
| n   | Particle velocity [4] ABC EM32                |       | -3.32        | 14.3 | 0.474| 0.134|     |
| o   | Multi-layer perceptron [14] MLMF Single       |       | -0.747       | 18.7 | 0.053| 0.0578|     |
| p   | Multi-layer perceptron P2 [14] MLMF Single    |       | -1.77        | 18.7 | 0.387| 0.0578|     |
| q   | Multi-layer perceptron P2 [14] MLMF Chromebook|       | -3.08        | 19.2 | 0.149| 0.059|     |
| r   | Multi-layer perceptron P2 [14] MLMF Mobile    |       | -2.26        | 18.3 | 0.302| 0.0555|     |
| s   | Multi-layer perceptron P2 [14] MLMF Crucif    |       | -1.83        | 20.6 | 0.312| 0.0569|     |
| t   | Multi-layer perceptron P2 [14] MLMF Lin8Ch    |       | -4.44        | 32.6 | 0.274| 0.0617|     |
| u   | Multi-layer perceptron P2 [14] MLMF EM32      |       | -2.86        | 18.6 | 0.212| 0.0574|     |
| v   | DENBE no noise reduction [24] ABC Chromebook  |       | -8.75        | 83   | 0.481| 0.0322|     |
| w   | DENBE spectral subtraction [5] ABC Chromebook  |       | -6.05        | 47.6 | 0.45 | 0.0588|     |
| x   | DENBE spec. sub. Gerkmann [24] ABC Chromebook |       | -6.05        | 47.5 | 0.46 | 0.048|     |
| y   | DENBE filtered subbands [5] ABC Chromebook    |       | -6.05        | 47.5 | 0.46 | 0.774|     |
| z   | DENBE FFT derived subbands [5] ABC Chromebook |       | -6.05        | 47.5 | 0.46 | 0.0452|     |
| 0   | NOSRMR Sec. 2.2. [15] SFM Chromebook         |       | -9.66        | 97.8 | 0.667| 1.03 |     |
| 1   | NOSRMR Sec. 2.2. [15] SFM Chromebook         |       | -7.29        | 57.5 | 0.639| 0.824|     |
| 2   | NOSRMR Sec. 2.2. [15] SFM Mobile             |       | -6.9         | 57   | 0.429| 1.58 |     |
| 3   | NOSRMR Sec. 2.2. [15] SFM Mobile             |       | -4.78        | 31.1 | 0.449| 1.26 |     |
| 4   | NOSRMR Sec. 2.2. [15] SFM Crucif             |       | -6.34        | 52   | 0.374| 2.61 |     |
| 5   | NOSRMR Sec. 2.2. [15] SFM Crucif             |       | -4.35        | 29.5 | 0.398| 2.08 |     |
| 6   | NOSRMR Sec. 2.2. [15] SFM Single             |       | -3.99        | 32.9 | -0.347| 0.543|     |
| 7   | NOSRMR Sec. 2.2. [15] SFM Single             |       | -4.13        | 34   | -0.397| 0.447|     |
| 8   | Per acoust. band SRMR Sec. 2.5. [15] SFM     |       | -3.44        | 28.6 | 0.136| 0.576|     |
| 9   | Temporal dynamics [25] SFM                    |       | -12.1        | 160  | 0.397| 0.0818|     |
| α   | QA Reverb [11] SFM                            |       | 2.22         | 20.8 | 0.198| 0.391|     |
| β   | Blind est. of coherent-to-diffuse energy ratio [9] |     | -14.3        | 211  | 0.451| 0.019|     |
4.3 Frequency-dependent DRR estimation results

Figure 50: Frequency-dependent DRR estimation error in all noises for all SNRs for algorithm Particle Velocity. 

Figure 50: Frequency-dependent DRR estimation error in all noises for all SNRs for algorithm Particle Velocity.
Figure 51: Frequency-dependent DRR estimation error in all noises for all SNRs for algorithm DENBE with FFT derived subbands [5]
Figure 52: Frequency-dependent DRR estimation error in all noises for all SNRs for algorithm DENBE with filtered subbands [5]
4.4 Frequency-dependent DRR estimation results by noise type

4.4.1 Ambient noise

Figure 53: Frequency-dependent DRR estimation error in ambient noise for all SNRs for algorithm Particle Velocity.
Figure 54: Frequency-dependent DRR estimation error in ambient noise for all SNRs for algorithm DENBE with FFT derived subbands [5]
Figure 55: Frequency-dependent DRR estimation error in ambient noise for all SNRs for algorithm DENBE with filtered subbands [5]
4.4.2 Babble noise

Figure 56: Frequency-dependent DRR estimation error in babble noise for all SNRs for algorithm Particle Velocity

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Figure 57: Frequency-dependent DRR estimation error in babble noise for all SNRs for algorithm DENBE with FFT derived subbands [5]
Figure 58: Frequency-dependent DRR estimation error in babble noise for all SNRs for algorithm DENBE with filtered subbands
4.4.3 Fan noise

![Graph showing frequency-dependent DRR estimation error in fan noise for all SNRs for algorithm Particle Velocity](image)

Figure 59: Frequency-dependent DRR estimation error in fan noise for all SNRs for algorithm Particle Velocity
Figure 60: Frequency-dependent DRR estimation error in fan noise for all SNRs for algorithm DENBE with FFT derived subbands.
Figure 61: Frequency-dependent DRR estimation error in fan noise for all SNRs for algorithm DENBE with filtered subbands [5]
4.5 Frequency-dependent DRR estimation results by noise type and SNR

4.5.1 Ambient noise at 18 dB

Figure 62: Frequency-dependent DRR estimation error in ambient noise at 18 dB SNR for algorithm Particle Velocity [4]
Figure 63: Frequency-dependent DRR estimation error in ambient noise at 18 dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 64: Frequency-dependent DRR estimation error in ambient noise at 18 dB SNR for algorithm DENBE with filtered subbands [5]
4.5.2 Ambient noise at 12 dB

Figure 65: Frequency-dependent DRR estimation error in ambient noise at 12 dB SNR for algorithm Particle Velocity.
Figure 66: Frequency-dependent DRR estimation error in ambient noise at 12 dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 67: Frequency-dependent DRR estimation error in ambient noise at 12 dB SNR for algorithm DENBE with filtered subbands [5]
4.5.3 Ambient noise at $-1 \, \text{dB}$

Figure 68: Frequency-dependent DRR estimation error in ambient noise at $-1 \, \text{dB SNR}$ for algorithm Particle Velocity [4]

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Figure 69: Frequency-dependent DRR estimation error in ambient noise at −1 dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 70: Frequency-dependent DRR estimation error in ambient noise at –1 dB SNR for algorithm DENBE with filtered subbands [5]
4.5.4 Babble noise at 18 dB

Figure 71: Frequency-dependent DRR estimation error in babble noise at 18 dB SNR for algorithm Particle Velocity

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Figure 72: Frequency-dependent DRR estimation error in babble noise at 18 dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 73: Frequency-dependent DRR estimation error in babble noise at 18 dB SNR for algorithm DENBE with filtered subbands \[5\]
4.5.5 Babble noise at 12 dB

Figure 74: Frequency-dependent DRR estimation error in babble noise at 12 dB SNR for algorithm Particle Velocity

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Figure 75: Frequency-dependent DRR estimation error in babble noise at 12 dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 76: Frequency-dependent DRR estimation error in babble noise at 12 dB SNR for algorithm DENBE with filtered subbands [5]
4.5.6 Babble noise at $-1 \text{ dB}$

Figure 77: Frequency-dependent DRR estimation error in babble noise at $-1 \text{ dB SNR}$ for algorithm Particle Velocity [4]
Figure 78: Frequency-dependent DRR estimation error in babble noise at $-1$ dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 79: Frequency-dependent DRR estimation error in babble noise at $-1$ dB SNR for algorithm DENBE with filtered subbands
4.5.7 Fan noise at 18 dB

![Frequency-dependent DRR estimation error in fan noise at 18 dB SNR for algorithm Particle Velocity](image)

Figure 80: Frequency-dependent DRR estimation error in fan noise at 18 dB SNR for algorithm Particle Velocity
Figure 81: Frequency-dependent DRR estimation error in fan noise at 18 dB SNR for algorithm DENBE with FFT derived subbands
Figure 82: Frequency-dependent DRR estimation error in fan noise at 18 dB SNR for algorithm DENBE with filtered subbands [5]
4.5.8 Fan noise at 12 dB

Figure 83: Frequency-dependent DRR estimation error in fan noise at 12 dB SNR for algorithm Particle Velocity [4]
Figure 84: Frequency-dependent DRR estimation error in fan noise at 12 dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 85: Frequency-dependent DRR estimation error in fan noise at 12 dB SNR for algorithm DENBE with filtered subbands [5]
4.5.9 Fan noise at $-1$ dB

Figure 86: Frequency-dependent DRR estimation error in fan noise at $-1$ dB SNR for algorithm Particle Velocity

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Figure 87: Frequency-dependent DRR estimation error in fan noise at −1 dB SNR for algorithm DENBE with FFT derived subbands [5]
Figure 88: Frequency-dependent DRR estimation error in fan noise at −1 dB SNR for algorithm DENBE with filtered subbands.
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