Supplementary Materials: Patient-Specific Planning for Thermal Magnetic Resonance of Glioblastoma Multiforme

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Supplementary Tables. Full hyperthermia treatment planning results for all patient models, RF applicator designs and optimization algorithms. The highest value of each metric per patient model and optimization algorithm is highlighted in bold. The inter-algorithm maximum is further highlighted by green font. The overall (inter-algorithm and inter-patient) maximum is further highlighted by a green background.

Table S1. Full VOP power optimization HTP results.

| VOP Power Optimization | 8.P.R | 16.P.R | 16.I.R | 16.E | 16.2.R.R | 16.2.R.E | 32.2.R.R | 32.2.R.E | 16.1.R.WB | 16.1.E.WB |
|------------------------|-------|--------|--------|------|---------|---------|---------|---------|-----------|-----------|
| **Pat Model 1**        |       |        |        |      |         |         |         |         |           |           |
| SAR<sub>max</sub>(TV)  | 57.3  | 73.4   | 96.4   | 94.8 | 100.3   | **108.3**| 70.7    | 85.6    | 104.6     | 79.9      |
| SAF                    | 2.0   | 2.0    | 2.7    | 2.9  | 3.5     | 2.4     | 3.0     | 3.1     | **3.8**   |           |
| TC<sub>SAR>Lim</sub>   | 18.8  | 37.2   | 45.5   | 43.0 | **59.1**| 55.6    | 47.9    | 50.2    | 32.5      | 46.3      |
| THQ                   | 0.8   | 1.0    | 1.2    | 1.2  | 1.3     | 1.3     | 1.2     | 1.2     | 1.0       | 1.1       |
| P<sub>Tv/Vtv</sub>    | 26.5  | 33.2   | 36.7   | 36.1 | **41.2**| **41.2**| 35.6    | 38.4    | 32.6      | 37.8      |
| # of excitations      | 2     | 2      | 2      | 1    | 1       | 2       | 2       | 2       | 1         | 1         |
| **Pat Model 2**        |       |        |        |      |         |         |         |         |           |           |
| SAR<sub>max</sub>(TV)  | 50.0  | 46.1   | 49.6   | 52.7 | 58.7    | 60.5    | 57.6    | 57.4    | 52.3      |           |
| SAF                    | 2.6   | 2.2    | 2.8    | 3.0  | 3.8     | 3.2     | 3.3     | 3.5     | 4.3       |           |
| TC<sub>SAR>Lim</sub>   | 16.2  | 8.5    | 18.7   | 18.5 | 28.0    | **30.4**| 27.3    | 23.6    | 25.5      |           |
| THQ                   | 0.9   | 0.9    | 1.0    | 1.0  | 1.1     | 1.1     | 1.0     | 1.1     | 1.0       |           |
| P<sub>Tv/Vtv</sub>    | 25.2  | 23.5   | 27.1   | 26.9 | 29.1    | 28.1    | 27.2    | 27.2    | 29.3      |           |
| # of excitations      | 2     | 2      | 2      | 1    | 2       | 2       | 1       | 1       | 1         |           |
| **Pat Model 3**        |       |        |        |      |         |         |         |         |           |           |
| SAR<sub>max</sub>(TV)  | 59.8  | 76.4   | 77.2   | 82.3 | 92.6    | **96.2**| 93.2    | 83.7    | 90.4      |           |
| SAF                    | 2.0   | 2.1    | 2.7    | 2.6  | 2.7     | 2.7     | 2.9     | 2.8     | 3.5       |           |
| TC<sub>SAR>Lim</sub>   | 26.2  | 45.2   | 38.4   | 45.6 | 67.0    | 71.4    | **76.0**| 58.6    | 58.4      |           |
| THQ                   | 0.9   | 1.1    | 1.2    | 1.2  | 1.3     | 1.3     | 1.3     | 1.3     | 1.2       |           |
| P<sub>Tv/Vtv</sub>    | 28.0  | 37.0   | 36.0   | 38.1 | 43.4    | **44.8**| 44.2    | 40.4    | 41.8      |           |
| # of excitations      | 2     | 2      | 2      | 1    | 1       | 1       | 1       | 1       | 1         |           |
| **Pat Model 4**        |       |        |        |      |         |         |         |         |           |           |
| SAR<sub>max</sub>(TV)  | 50.0  | 49.4   | 49.0   | 51.5 |         |         |         |         |           | **54.9**  |
| SAF                    | 3.0   | 2.9    | 2.7    | 2.4  |         |         |         |         |           | 3.2       |
| TC<sub>SAR>Lim</sub>   | 22.4  | 22.3   | 20.0   | 21.6 |         |         |         |         |           | 34.1      |
| THQ                   | 0.9   | 0.9    | 0.9    | 0.9  |         |         |         |         |           | 1.0       |
| P<sub>Tv/Vtv</sub>    | 30.2  | 30.0   | 29.7   | 3.6  |         |         |         |         |           | 33.0      |
| # of excitations      | 1     | 1      | 2      | 2    |         |         |         |         |           | 1         |
| **Pat Model 5**        |       |        |        |      |         |         |         |         |           |           |
| SAR<sub>max</sub>(TV)  | 44.0  | 46.5   | **71.8**| 48.5 |         |         |         |         |           | 52.5      |
| SAF                    | 2.8   | 2.8    | 4.3    | 3.3  |         |         |         |         |           | 5.2       |
| TC<sub>SAR>Lim</sub>   | 8.8   | 12.8   | **42.2**| 22.4 |         |         |         |         |           | 26.9      |
| THQ                   | 0.9   | 1.0    | 1.2    | 1.0  |         |         |         |         |           | 1.0       |
| P<sub>Tv/Vtv</sub>    | 26.8  | 27.7   | **38.2**| 28.2 |         |         |         |         |           | 28.6      |
| # of excitations      | 2     | 2      | 1      | 1    |         |         |         |         |           | 1         |

**Pat Model 6**

| SAR<sub>max</sub>(TV)  | 114.8 | 83.1  | 100.1 | 80.9 |         |
| SAF                    | 4.6   | **5.1**| 5.8   | 4.9  |         |
| TC<sub>SAR>Lim</sub>   | **65.8**| 40.8  | 41.9  | 35.5 |         |
| Pat Model 7 | SAR_{max}(TV) | SAF | TCSAR>Lim | THQ | PTV/VTV | # of excitations |
|------------|--------------|-----|-----------|-----|---------|-----------------|
| 1.5        | 1.4          | 1.4 | 1.3       |     |         | 1               |
| 46.1       | 37.9         | 40.2| 36.1      |     |         | 1               |

| Pat Model 8 | SAR_{max}(TV) | SAF | TCSAR>Lim | THQ | PTV/VTV | # of excitations |
|------------|--------------|-----|-----------|-----|---------|-----------------|
| 1.2        | 1.4          |     | 1.4       |     | 1.4     | 1               |
| 70.9       | 86.5         | 91.2| 73.4      |     |         | 1               |

| Pat Model 9 | SAR_{max}(TV) | SAF | TCSAR>Lim | THQ | PTV/VTV | # of excitations |
|------------|--------------|-----|-----------|-----|---------|-----------------|
| 1.3        | 1.3          |     |          |     | 1.3     | 3               |
| 74.9       | 79.2         | 88.8| 93.9      |     |         | 2               |

The highest value of each metric per patient model and optimization algorithm is highlighted in bold. The inter-algorithm maximum is further highlighted by green font. The overall (inter-algorithm and inter-patient) maximum is further highlighted by a green background.
Table S2. Full VOP uniformity optimization HTP results.

| Pat Model | SAR\(_{\text{max}}\)(TV) | SAF | TC\(_{\text{SAR-Lim}}\) | THQ | PTV/VTV | # of excitations |
|-----------|-----------------|-----|-----------------|-----|---------|-----------------|
| Model 1   | 45.2            | 1.8 | 3.2             | 0.8 | 24.5    | 2               |
|           | 61.1            | 2.1 | 20.5            | 1.0 | 29.5    | 2               |
|           | 82.4            | 2.4 | 47.5            | 1.1 | 36.0    | 2               |
|           | 80.9            | 2.6 | 45.8            | 1.1 | 36.2    | 2               |
|           | 75.5            | 2.6 | 49.6            | 1.1 | 36.0    | 2               |
|           | 91.3            | 3.0 | 46.7            | 1.2 | 37.4    | 3               |
|           | 59.6            | 2.5 | 31.9            | 1.0 | 32.0    | 2               |
|           | 85.4            | 2.5 | 43.7            | 1.1 | 36.1    | 2               |
|           | 101.1           | 3.5 | 29.7            | 1.0 | 31.7    | 3               |
|           | 69.5            | 3.0 | 29.9            | 0.9 | 33.8    |                 |
| Model 2   | 50.4            | 2.3 | 13.3            | 0.8 | 22.6    | 3               |
|           | 47.6            | 2.5 | 8.9             | 0.9 | 21.1    | 2               |
|           | 50.7            | 3.1 | 12.9            | 0.9 | 24.8    | 2               |
|           | 50.7            | 2.9 | 12.9            | 0.9 | 25.3    | 2               |
|           | 58.6            | 3.8 | 28.6            | 1.0 | 28.4    | 3               |
|           | 59.5            | 3.1 | 25.9            | 1.0 | 26.2    | 2               |
|           | 49.3            | 2.8 | 13.7            | 0.9 | 23.1    | 2               |
|           | 54.4            | 3.4 | 20.5            | 1.0 | 25.4    | 3               |
|           | 41.9            |     |                 |     |         |                 |
| Model 3   | 49.9            | 2.2 | 11.1            | 0.9 | 22.4    | 2               |
|           | 74.4            | 2.3 | 43.3            | 1.2 | 36.8    | 2               |
|           | 75.5            | 3.1 | 44.1            | 1.2 | 37.1    | 2               |
|           | 75.8            | 2.9 | 44.1            | 1.2 | 36.7    | 2               |
|           | 73.9            | 3.8 | 44.2            | 1.1 | 37.0    | 3               |
|           | 82.7            | 3.1 | 51.3            | 1.2 | 39.4    | 3               |
|           | 74.2            | 2.8 | 48.7            | 1.2 | 37.6    | 3               |
|           | 68.3            | 3.4 | 36.7            | 1.2 | 34.6    | 3               |
|           | 81.4            |     |                 |     |         |                 |
| Model 4   | 44.1            | 2.5 | 5.4             | 0.9 | 28.1    | 2               |
|           | 43.6            | 2.3 | 2.7             | 0.9 | 27.2    | 2               |
|           | 47.2            | 2.3 | 12.1            | 0.9 | 29.9    | 3               |
|           | 47.2            | 2.3 | 10.4            | 0.9 | 29.0    | 2               |
|           |                 |     |                 |     |         |                 |
| Model 5   | 39.3            | 2.3 | 0.0             | 0.8 | 23.4    | 2               |
|           | 41.3            | 2.2 | 0.7             | 0.8 | 24.0    | 2               |
|           | 54.1            | 2.9 | 26.0            | 1.0 | 32.6    | 2               |
|           | 42.6            | 2.7 | 2.7             | 0.9 | 26.9    | 3               |
|           |                 |     |                 |     |         |                 |
| Model 6   | 65.4            | 2.5 | 30.9            | 1.0 | 32.6    | 2               |
|           | 71.6            | 3.3 | 36.3            | 1.2 | 36.6    | 2               |
|           | 88.7            | 3.4 | 41.0            | 1.1 | 39.2    | 3               |
|           | 71.2            | 3.4 | 37.7            | 1.1 | 36.5    |                 |
|           |                 |     |                 |     |         |                 |
| Model 7   | 62.4            | 3.8 | 37.9            | 1.2 | 32.0    | 2               |
|           | 73.9            | 3.7 | 46.7            | 1.2 | 35.0    | 2               |
|           | 74.5            | 3.4 | 56.1            | 1.2 | 36.6    | 3               |
|           | 74.6            | 3.4 | 61.1            | 1.2 | 37.1    |                 |
|           |                 |     |                 |     |         |                 |
| Model 8   | 55.7            | 2.1 | 3.8             | 0.8 | 24.4    | 2               |
|           | 57.5            | 1.9 | 3.7             | 0.9 | 23.7    | 2               |
|           | 67.1            | 1.9 | 10.7            | 0.9 | 24.7    | 2               |
|           | 50.2            | 1.7 | 7.8             | 0.8 | 24.7    |                 |
|                  | # of excitations | 3   | 3   | 2   | 3   |
|-----------------|------------------|-----|-----|-----|-----|
| SAR$_\text{max}(\text{TV})$ |                  | 53.3| 53.0| 75.4| 71.9|
| SAF              |                  | 1.9 | 1.9 | 2.0 | **2.1** |
| TC$_{\text{SAR}>\text{Lim}}$ |                | 17.9| 21.3| **53.5** | 50.3 |
| THQ              |                  | 0.9 | 0.9 | **1.2** | 1.1 |
| P$_{TV}/V_{TV}$  |                  | 29.1| 30.6| **41.0** | 39.8 |

- **Pat Model 9**

|                  | # of excitations | 3   | 3   | 2   | 3   |
|------------------|------------------|-----|-----|-----|-----|
| SAR$_\text{max}(\text{TV})$ |                  | 53.3| 53.0| **75.4** | 71.9 |
| SAF              |                  | 1.9 | 1.9 | **2.1** | 2.0 |
| TC$_{\text{SAR}>\text{Lim}}$ |                | 17.9| 21.3| **53.5** | 50.3 |
| THQ              |                  | 0.9 | 0.9 | **1.2** | 1.1 |
| P$_{TV}/V_{TV}$  |                  | 29.1| 30.6| **41.0** | 39.8 |
### Table S3. Full MVFS optimization HTP results.

| Pat Model | SAR<sub>max</sub>(TV) | SAF | TCSAR<sub>Lim</sub> | THQ | P<sub>TV/VTV</sub> | # of excitations |
|-----------|------------------------|-----|---------------------|------|-------------------|------------------|
| **Model 1** | | | | | | |
| 8.P.R | 59.5 | 2.0 | 17.3 | 0.8 | 27.2 | 2 |
| 16.P.R | 74.0 | 2.0 | 46.2 | 1.1 | 34.9 | 2 |
| 16.I.R | 104.6 | 2.6 | 63.9 | 1.2 | 41.5 | 2 |
| 16.2.R.R | 114.6 | 2.9 | 67.4 | 1.3 | 45.1 | 2 |
| 16.2.R.E | 119.5 | 2.8 | 83.5 | 1.5 | 49.4 | 2 |
| 32.2.R.R | 134.2 | 3.3 | 76.5 | 1.4 | 66.8 | 2 |
| 32.2.R.E | 112.9 | 2.6 | 83.0 | 1.5 | 48.5 | 3 |
| 16.I.R.WB | 121.9 | 3.1 | 82.7 | 1.1 | 51.5 | 3 |
| 16.I.E.WB | 112.4 | 3.1 | 39.9 | 1.1 | 35.3 | 3 |
| **Model 2** | | | | | | |
| SAR<sub>max</sub>(TV) | 53.1 | 2.6 | 20.3 | 0.9 | 25.6 | 2 |
| SAF | 51.4 | 2.3 | 40.5 | 1.0 | 31.3 | 2 |
| TCSAR<sub>Lim</sub> | 55.6 | 3.2 | 83.4 | 1.1 | 37.8 | 3 |
| THQ | 62.0 | 3.3 | 73.7 | 1.3 | 35.0 | 3 |
| P<sub>TV/VTV</sub> | 74.0 | 3.4 | 84.0 | 1.2 | 38.1 | 3 |
| # of excitations | 117.5 | 3.9 | 83.6 | 1.1 | 40.0 | 3 |
| **Model 3** | | | | | | |
| SAR<sub>max</sub>(TV) | 66.1 | 2.2 | 24.2 | 1.0 | 26.3 | 3 |
| SAF | 81.5 | 2.9 | 56.6 | 1.1 | 45.7 | 3 |
| TCSAR<sub>Lim</sub> | 98.2 | 3.2 | 87.0 | 1.2 | 48.7 | 4 |
| THQ | 90.9 | 3.4 | 79.9 | 1.3 | 46.9 | 4 |
| P<sub>TV/VTV</sub> | 104.3 | 3.4 | 100.8 | 1.4 | 53.1 | 4 |
| # of excitations | 109.1 | 3.6 | 114.4 | 1.5 | 51.6 | 4 |
| **Model 4** | | | | | | |
| SAR<sub>max</sub>(TV) | 58.2 | 2.3 | 38.4 | 1.0 | 34.5 | 3 |
| SAF | 58.3 | 2.5 | 42.6 | 1.0 | 35.3 | 3 |
| TCSAR<sub>Lim</sub> | 59.9 | 2.1 | 49.1 | 1.1 | 36.3 | 3 |
| THQ | 66.9 | 2.2 | 50.8 | 1.1 | 37.4 | 3 |
| P<sub>TV/VTV</sub> | 61.3 | 3.1 | 49.0 | 1.1 | 36.5 | 3 |
| # of excitations | 99.3 | 3.1 | 71.8 | 1.1 | 45.8 | 3 |
| **Model 5** | | | | | | |
| SAR<sub>max</sub>(TV) | 52.4 | 2.2 | 38.4 | 1.0 | 29.9 | 3 |
| SAF | 56.2 | 2.9 | 42.6 | 1.0 | 31.1 | 3 |
| TCSAR<sub>Lim</sub> | 86.1 | 2.6 | 49.1 | 1.1 | 47.7 | 3 |
| THQ | 90.9 | 2.7 | 79.9 | 1.2 | 46.9 | 3 |
| P<sub>TV/VTV</sub> | 58.2 | 2.3 | 58.2 | 1.1 | 34.4 | 3 |
| # of excitations | 58.5 | 3.3 | 46.9 | 1.1 | 34.0 | 3 |
| **Model 6** | | | | | | |
| SAR<sub>max</sub>(TV) | 126.4 | 4.1 | 80.8 | 1.5 | 53.1 | 2 |
| SAF | 112.3 | 3.7 | 83.1 | 1.5 | 53.6 | 2 |
| TCSAR<sub>Lim</sub> | 143.9 | 3.7 | 80.9 | 1.6 | 56.8 | 2 |
| THQ | 119.0 | 3.1 | 79.8 | 1.5 | 53.5 | 2 |
| P<sub>TV/VTV</sub> | 114.3 | 3.1 | 98.8 | 1.5 | 52.8 | 2 |
| # of excitations | 3 |
| **Model 7** | | | | | | |
| SAR<sub>max</sub>(TV) | 87.8 | 3.8 | 77.6 | 1.3 | 42.8 | 2 |
| SAF | 107.0 | 3.9 | 89.7 | 1.5 | 49.0 | 2 |
| TCSAR<sub>Lim</sub> | 97.8 | 3.5 | 90.5 | 1.5 | 47.1 | 2 |
| THQ | 114.3 | 4.0 | 95.8 | 1.6 | 52.8 | 2 |
| P<sub>TV/VTV</sub> | 3 |
| **Model 8** | | | | | | |
| SAR<sub>max</sub>(TV) | 95.2 | 2.6 | 53.0 | 1.1 | 36.3 | 2 |
| SAF | 107.5 | 2.7 | 61.7 | 1.2 | 38.6 | 2 |
| TCSAR<sub>Lim</sub> | 115.8 | 2.5 | 63.1 | 1.2 | 41.0 | 2 |
| THQ | 90.5 | 2.5 | 58.3 | 1.2 | 38.1 | 2 |
| Metric          | # of excitations | 2  | 3  | 2  | 2  |
|-----------------|------------------|----|----|----|----|
| SAR_{max}(TV)   |                  | 82.8 | 88.3 | 96.9 | **99.7** |
| SAF             |                  | 2.3  | 2.3 | 2.4 | **2.4** |
| TC_{SAR>lim}    |                  | 56.7 | 64.8 | **69.3** | 69.0 |
| THQ             |                  | 1.2  | 1.2 | 1.3 | **1.3** |
| P_{TV/V_{TV}}   |                  | 41.5 | 44.5 | 48.3 | **49.1** |

The highest value of each metric per patient model and optimization algorithm is highlighted in bold. The inter-algorithm maximum is further highlighted by green font. The overall (inter-algorithm and inter-patient) maximum is further highlighted by a green background.