Table S1. Parameter sensitivity of the estimated shoulder position errors (Euclidean distance) for a large disagreement between the assumed and the actual IMU-to-elbow distance $A_E$. Abbreviations: Proper movement (Prop.Mov.), Compensatory movement (Comp.Mov.), Distance (Dist.), Percentile (%ile).

| Subject | Type         | Original Error [cm] | Change of the Errors [cm] |
|---------|--------------|---------------------|--------------------------|
|         |              | Dist. IMU to Elbow $A_E = 15$ cm | Changed to half value: $A_E = 7.5$ cm |
|         |              | Median 5th %ile 95th %ile | Median 5th %ile 95th %ile |
| S1 Prop.Mov. | 4.19 1.94 8.25 | 0.12 0.01 0.17 |
| S1 Comp.Mov. | 3.94 1.21 8.61 | 0.06 0.09 -0.09 |
| S2 Prop.Mov. | 2.81 0.80 5.23 | 0.09 0.00 0.14 |
| S2 Comp.Mov. | 3.63 1.11 6.95 | 0.06 -0.03 0.20 |
| S3 Prop.Mov. | 4.98 1.00 9.75 | 0.14 0.06 0.31 |
| S3 Comp.Mov. | 4.52 1.70 9.17 | -0.10 -0.19 0.24 |
| S4 Prop.Mov. | 3.79 1.35 6.59 | 0.10 0.00 0.11 |
| S4 Comp.Mov. | 4.60 1.43 9.40 | -0.03 -0.08 -0.14 |
| S5 Prop.Mov. | 3.37 1.28 6.70 | 0.04 -0.01 0.13 |
| S5 Comp.Mov. | 3.83 0.88 8.66 | 0.11 0.11 0.65 |
| Average Prop.Mov. | 3.97 1.27 7.93 | 0.06 0.00 0.17 |
| Average Comp.Mov. |            | 1.5% -0.3% 2.2% |
### Table S2. Parameter sensitivity of the estimated elbow angle errors for a large disagreement between the assumed and the actual IMU-to-elbow distance $A_{PE}$. Abbreviations: Proper movement (Prop.Mov.), Compensatory movement (Comp.Mov.), Distance (Dist.), Percentile (%ile).

| Subject Type | Dist. IMU to Elbow $A_{PE} = 15$ cm | Changed to half value: $A_{PE} = 7.5$ cm |
|--------------|------------------------------------|-----------------------------------------|
|              | Median 5th %ile 95th %ile | Median 5th %ile 95th %ile |
| S1           | Prop.Mov. | 1.79 0.17 5.79 | 0.05 0.00 -0.01 |
|              | Comp.Mov. | 4.01 0.41 9.23 | -0.28 -0.01 -0.47 |
| S2           | Prop.Mov. | 2.31 0.21 6.43 | 0.13 0.00 0.12 |
|              | Comp.Mov. | 3.90 0.34 9.22 | 0.19 0.03 0.62 |
| S3           | Prop.Mov. | 3.12 0.33 8.42 | 0.38 0.02 1.04 |
|              | Comp.Mov. | 3.38 0.24 10.13 | 0.00 0.12 -0.75 |
| S4           | Prop.Mov. | 2.50 0.27 6.53 | 0.25 0.02 0.95 |
|              | Comp.Mov. | 2.95 0.24 8.41 | 0.14 0.12 0.24 |
| S5           | Prop.Mov. | 2.19 0.22 5.94 | 0.13 -0.01 0.37 |
|              | Comp.Mov. | 3.67 0.27 11.37 | 1.14 0.37 1.94 |
| Average      | Prop.Mov. | 2.98 0.27 8.15 | 0.21 0.07 0.41 |
|              | Comp.Mov. | 8.15 0.27 24.4% | 7.1% 4.1% 5.0% |

Average relative change
Table S3. Parameter sensitivity of the estimated shoulder position errors (Euclidean distance) for typical to-be-expected variations (±2.5 cm) in the manually measured upper arm length $l_A$. Abbreviations: Proper movement (Prop.Mov.), Compensatory movement (Comp.Mov.), Percentile (%ile).

| Subject | Type     | Original Error [cm] | Change of the Errors [cm] |
|---------|----------|---------------------|--------------------------|
|         |          | Median 5th %ile 95th %ile | Changed: $l_A$ +2.5 cm        | Changed: $l_A$ -2.5 cm        |
|         |          | Median 5th %ile 95th %ile | Median 5th %ile 95th %ile  | Median 5th %ile 95th %ile        |
| S1      | Prop.Mov.| 4.19 1.94 8.25 | -0.01 0.04 0.75 | 0.18 -0.13 -0.61 |
|         | Comp.Mov.| 3.94 1.21 8.61 | -0.04 -0.26 0.85 | 0.19 0.35 -0.65 |
| S2      | Prop.Mov.| 2.81 0.80 5.23 | 0.06 -0.07 0.35 | 0.07 0.09 0.17 |
|         | Comp.Mov.| 3.63 1.11 6.95 | -0.01 -0.06 0.13 | 0.02 0.11 -0.06 |
| S3      | Prop.Mov.| 4.98 1.00 9.75 | 0.38 0.10 0.95 | -0.21 -0.03 -0.72 |
|         | Comp.Mov.| 4.52 1.70 9.17 | -0.07 -0.46 0.78 | 0.18 0.54 -0.46 |
| S4      | Prop.Mov.| 3.79 1.35 6.59 | 0.15 -0.06 0.60 | -0.05 0.23 -0.21 |
|         | Comp.Mov.| 4.60 1.43 9.40 | -0.01 -0.07 -0.12 | 0.10 0.20 0.17 |
| S5      | Prop.Mov.| 3.37 1.28 6.70 | 0.12 -0.13 0.77 | 0.05 0.13 -0.60 |
|         | Comp.Mov.| 3.83 0.88 8.66 | -0.05 0.15 0.72 | 0.15 0.22 -0.65 |
| Average |          | 3.97 1.27 7.93 | 0.05 -0.08 0.58 | 0.07 0.17 -0.36 |
|         |          |                      | Average relative change |                                                |
|         |          | 1.3% -6.5% 7.3% | 1.7% 13.5% -4.6% |                                               |
Table S4. Parameter sensitivity of the estimated shoulder position errors (Euclidean distance) for variations of the cutoff frequency of the Butterworth filter for the determination of the time derivative $\dot{\omega}$. Abbreviations: Proper movement (Prop. Mov.), Compensatory movement (Comp. Mov.).

| Subject | Type        | Original Error [cm] | Change of the Errors [cm] |
|---------|-------------|---------------------|---------------------------|
|         |             | Cutoff frequency = 2.5 Hz | Changed: Cutoff frequency +1 Hz | Changed: Cutoff frequency -1 Hz |
|         |             | Median | 5th %ile | 95th %ile | Median | 5th %ile | 95th %ile | Median | 5th %ile | 95th %ile |
| S1      | Prop. Mov.  | 4.19   | 1.94     | 8.25     | 0.00   | 0.00     | 0.00     | -0.01 | 0.00     | 0.00     |
|         | Comp. Mov.  | 3.94   | 1.21     | 8.61     | 0.00   | 0.00     | 0.00     | 0.00  | 0.00     | 0.01     |
| S2      | Prop. Mov.  | 2.81   | 0.80     | 5.23     | 0.00   | 0.00     | 0.00     | 0.00  | 0.00     | 0.00     |
|         | Comp. Mov.  | 3.63   | 1.11     | 6.95     | 0.00   | 0.00     | 0.00     | 0.00  | 0.00     | 0.00     |
| S3      | Prop. Mov.  | 4.98   | 1.00     | 9.75     | 0.01   | -0.01    | 0.01     | 0.00  | 0.00     | 0.00     |
|         | Comp. Mov.  | 4.52   | 1.70     | 9.17     | 0.00   | 0.00     | 0.01     | 0.00  | 0.00     | 0.00     |
| S4      | Prop. Mov.  | 3.79   | 1.35     | 6.59     | 0.00   | 0.00     | 0.00     | 0.00  | 0.00     | 0.00     |
|         | Comp. Mov.  | 4.60   | 1.43     | 9.40     | 0.00   | 0.00     | 0.00     | 0.00  | 0.00     | 0.00     |
| S5      | Prop. Mov.  | 3.37   | 1.28     | 6.70     | 0.00   | 0.00     | 0.00     | 0.00  | 0.00     | 0.00     |
|         | Comp. Mov.  | 3.83   | 0.88     | 8.66     | 0.00   | 0.00     | 0.00     | -0.08 | 0.00     | 0.00     |
| Average |             | 3.97   | 1.27     | 7.93     | 0.00   | 0.00     | 0.00     | -0.01 | 0.00     | 0.00     |
| Average relative change | 0.0%  | -0.1%    | 0.0%     | 0.0%   | -0.2%  | 0.0%     | 0.0%     |
Table S5. Parameter sensitivity of the estimated elbow angle errors for variations of the cutoff frequency of the Butterworth filter for the determination of the time derivative ˙\omega_A. Abbreviations: Proper movement (Prop. Mov.), Compensatory movement (Comp. Mov.), Percentile (%ile).

| Subject | Type      | Original Error [°] | Change of the Errors [°] |
|---------|-----------|--------------------|--------------------------|
|         | Cutoff frequency = 2.5 Hz | Changed: Cutoff frequency +1 Hz | Changed: Cutoff frequency -1 Hz |
|         | Median 5th %ile 95th %ile | Median 5th %ile 95th %ile | Median 5th %ile 95th %ile |
| S1      | Prop. Mov. | 1.79 0.17 5.79     | 0.00 0.00 0.00           | 0.00 0.00 -0.02 |
|         | Comp. Mov. | 4.01 0.41 9.23     | 0.00 0.00 0.00           | 0.01 0.01 0.02 |
| S2      | Prop. Mov. | 2.31 0.21 6.43     | 0.00 0.00 0.00           | 0.00 0.00 0.00 |
|         | Comp. Mov. | 3.90 0.34 9.22     | 0.00 0.00 0.00           | 0.00 0.00 0.00 |
| S3      | Prop. Mov. | 3.12 0.33 8.42     | -0.01 -0.01 0.01         | 0.00 0.00 0.00 |
|         | Comp. Mov. | 3.38 0.24 10.13    | 0.01 0.00 0.02           | 0.00 0.00 0.00 |
| S4      | Prop. Mov. | 2.50 0.27 6.53     | 0.00 0.00 0.00           | 0.00 0.00 0.00 |
|         | Comp. Mov. | 2.95 0.24 8.41     | 0.00 0.00 0.00           | 0.00 0.00 0.00 |
| S5      | Prop. Mov. | 2.19 0.22 5.94     | 0.00 0.00 0.00           | 0.00 0.00 0.00 |
|         | Comp. Mov. | 3.67 0.27 11.37    | 0.00 0.00 0.00           | -0.03 -0.02 0.00 |
| Average |           | 2.98 0.27 8.15     | 0.00 0.00 0.00           | 0.00 0.00 0.00 |
| Average relative change | | 0.0% -0.4% 0.0% | -0.1% -0.4% 0.0% |