

Supplementary Materials: Black box modeling of prefrontal fNIRS-pupillometry of short-duration frontal tDCS effects – a healthy case series

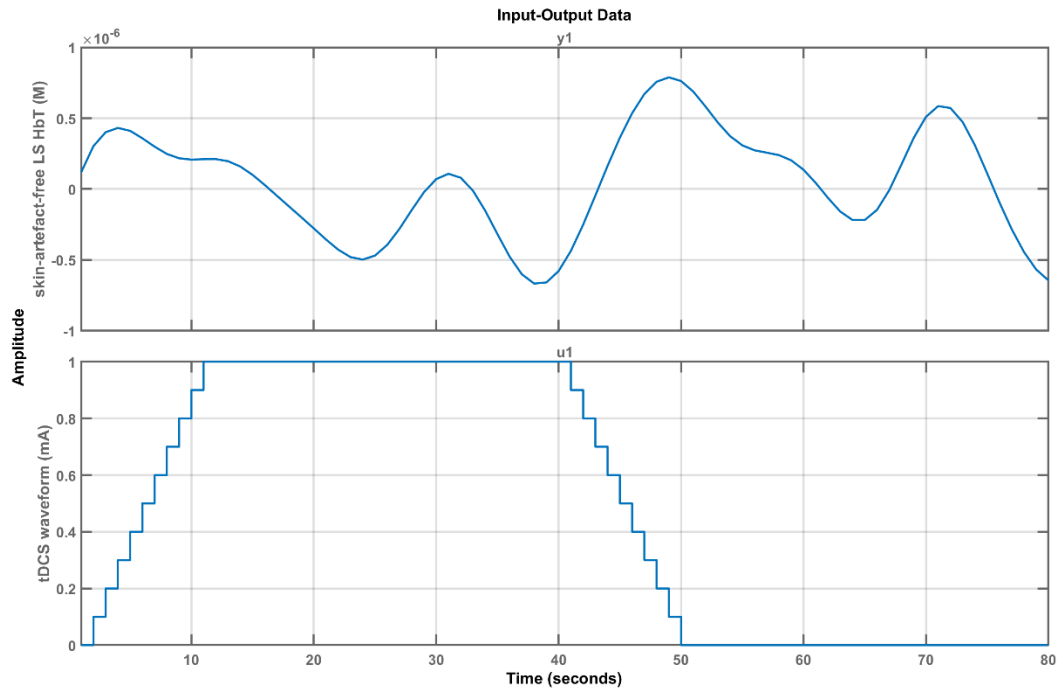


Figure S1: An illustrative plot of the skin-artefact-free long separation (LS) total hemoglobin changes (HbT) evoked by the tDCS ON waveform (mA).

1. The model from tDCS waveform input to LS HbT output (tDCS=>LS) was initialized with reduced-dimension model (8 poles, 2 zeros (Arora et al., 2021c)) for Pathway 3: Perivascular Potassium → vessel circumference.

tDCS=>LS HbT

$$-8.334e-11 s^2 + 2.995e-11 s + 4.422e-12$$

$$s^8 + 0.2545 s^7 + 0.3353 s^6 + 0.07136 s^5 + 0.03394 s^4 + 0.005443 s^3 + 0.001251 s^2 + 0.000122 s + 1.216e-05$$

Continuous-time identified transfer function.

Parameterization:

Number of poles: 8 Number of zeros: 2

Number of free coefficients: 11

Status:

Estimated using TFEST on time domain data.

Fit to estimation data: 54.55% (stability enforced)

FPE: 8.843e-13, MSE: 5.449e-13

2. The model from tDCS waveform input to SS HbT output (tDCS=>SS) was initialized with reduced-dimension model (6 poles, 1 zeros (Arora et al., 2021c)) for Pathway 4: Smooth muscle cell → vessel circumference.

tDCS=>SS HbT

$$-8.334e-11 s^2 + 2.995e-11 s + 4.422e-12$$

$$s^8 + 0.2545 s^7 + 0.3353 s^6 + 0.07136 s^5 + 0.03394 s^4 + 0.005443 s^3 + 0.001251 s^2 + 0.000122 s + 1.216e-05$$

Continuous-time identified transfer function.

Parameterization:

Number of poles: 8 Number of zeros: 2

Number of free coefficients: 11

Status:

Estimated using TFEST on time domain data.

Fit to estimation data: 54.55% (stability enforced)

FPE: 8.843e-13, MSE: 5.449e-13

3. The model from SS HbT input to LS HbT output (SS=>LS) was a static gain model.

SS HbT=>LS HbT

$$2.361$$

Static gain.

Parameterization:

Number of poles: 0 Number of zeros: 0

Number of free coefficients: 1

Status:

Estimated using TFEST on time domain data.

Fit to estimation data: 76.61% (stability enforced)

FPE: 1.479e-13, MSE: 1.443e-13

4. The model from tDCS waveform input to skin-artefact-free LS HbT output (LS – (SS=>LS)) was initialized with reduced-dimension model (8 poles, 2 zeros (Arora et al., 2021c)) for Pathway 3: Perivascular Potassium → vessel circumference.

LS HbT – (SS HbT=>LS HbT)

$$2.022\text{e-}10\text{ s}^2 + 7.678\text{e-}12\text{ s} + 1.374\text{e-}13$$

$$\text{s}^8 + 0.4073\text{ s}^7 + 0.4445\text{ s}^6 + 0.128\text{ s}^5 + 0.05998\text{ s}^4 + 0.01001\text{ s}^3 + 0.002776\text{ s}^2 + 0.000161\text{ s} + 2.749\text{e-}05$$

Continuous-time identified transfer function.

Parameterization:

Number of poles: 8 Number of zeros: 2

Number of free coefficients: 11

Status:

Estimated using TFEST on time domain data "dataLSminusSS".

Fit to estimation data: 71.14% (stability enforced)

FPE: 1.915e-14, MSE: 1.18e-14