All montages that are linear transforms (which is all of the ones I've ever used) can be generated on-demand from <u>Referential</u> (system / machine ref) instantly:

$$\bar{Y} = \bar{M} \cdot \bar{X} + B$$

where $\bar{X}$ is the referential data in the form

$$\begin{bmatrix} X_{11} & X_{12} \cdots & X_{1N} \\ \vdots & & \\ X_{M1} & X_{M2} & \cdots X_{MN} \end{bmatrix}$$

$\bar{M}$ is a $m \times m$ linear transform matrix

B is constant (at least over the time frame of the data in $\bar{X}$)

Example 1. X is referential data with channels ordered as Fp1, F3, C3, P3, O1, FP2, F4, C4, P4, O2

$$\begin{bmatrix} FP1_1 & \cdots\cdots & FP1_n \\ F3_1 & \cdots & F3_n \\ \vdots & & \\ O2_1 & \cdots & O2_n \end{bmatrix}$$

I want the order to be L/R comparisons

(FP1, FP2, F3, F4, C3, C4 ...)

Then the transform matrix is

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

B is ϕ

Example 2. I want a bipolar montage.

Data in $\overline{X}$ is same as Ex 1.

(Bipolar here will be FP1 − F3, F3 − C3, C3 − P3 ...)

Then $\overline{M}$ is

$$
\begin{bmatrix}
1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 \\
\vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots
\end{bmatrix}
$$

B is $\emptyset$

Ex 2b I want transverse bipolar, L→R

Fp1 − Fp2, F7 − F3, F3 − Fz, Fz − F4, F4 − F8, ...

$$
\begin{array}{lllllllllll}
\text{Fp1} & \text{F3} & \text{C3} & \text{P3} & \text{O1} & \text{Fp2} & \text{F4} & \text{C4} & \text{P4} & \text{O2} & \cdots \\
\hline
1 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & \cdots
\end{array}
$$

B is $\emptyset$

Ex 3 Average Ref (uniform Laplacian)

Same data as in 1

Then $\bar{M}$ is identity

$$\begin{bmatrix} 1 & 0 & 0 & \cdots \\ 0 & 1 & 0 & \cdots \\ 0 & 0 & 1 & \cdots \\ \vdots & \vdots & \vdots & \end{bmatrix}$$

But B is $\begin{bmatrix} \frac{-1}{M} & \frac{-1}{M} & \frac{-1}{M} & \cdots \\ \frac{-1}{M} & \frac{-1}{M} & \cdots & \\ \vdots & \vdots & & \end{bmatrix} * \bar{X}$ (which is $\frac{-1}{M} \cdot \text{ones}(m \times m)$ where m is #chans)

But this simplifies to $\bar{Y} = (\bar{M} + \bar{B}) \cdot \bar{X}$

and

$$\bar{M} + \bar{B} = \begin{bmatrix} \frac{M-1}{m} & \frac{-1}{m} & \frac{-1}{m} & \frac{-1}{m} & \cdots \\ \frac{-1}{m} & \frac{M-1}{m} & \frac{-1}{m} & \frac{-1}{m} & \cdots \\ \frac{-1}{m} & \frac{-1}{m} & \frac{M-1}{m} & \frac{-1}{m} & \cdots \\ \vdots & \vdots & \vdots & \vdots & \end{bmatrix}$$

Ex 4. Regional Laplacian similar to Ex 3, but custom weighing matrix Req'd

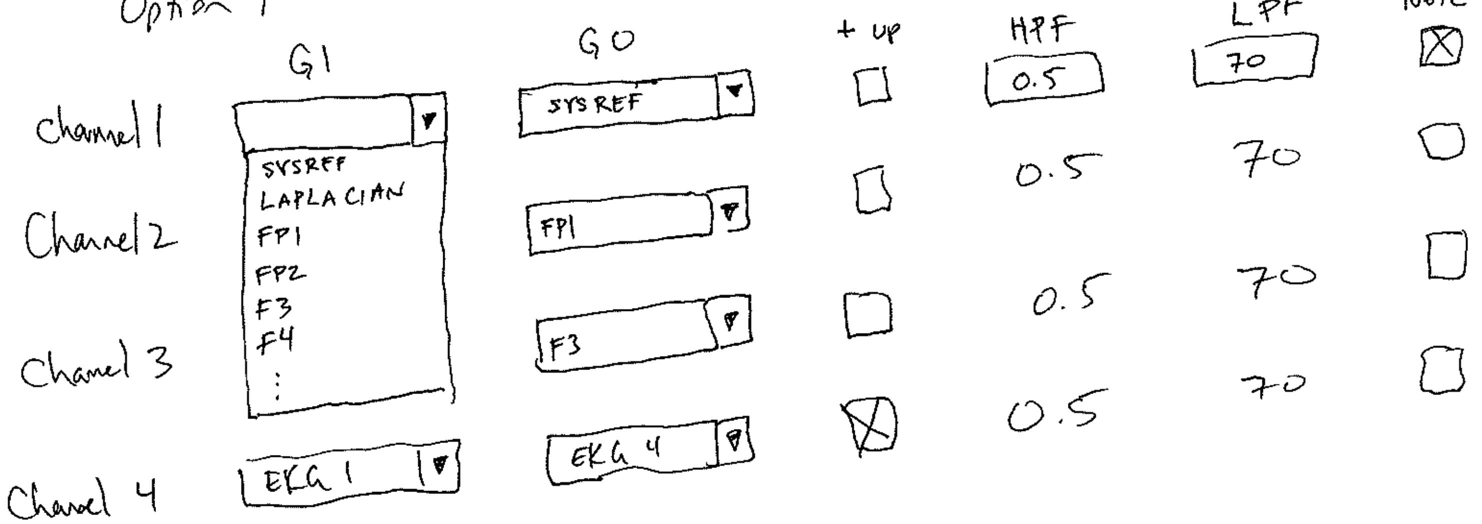
like this..

$$\bar{M} = \begin{bmatrix} 1 & 0.5 & 0.2 & 0 & 0 & \cdots \\ 0 & 0.25 & 0.5 & 1 & 0.5 & \cdots \\ 0 & 0 & 0.25 & 0.5 & 1 & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \end{bmatrix}$$

$\bar{M}$ should be predefined for some data sets that contain 10-20 EEG (bipolar-longitudinal, transverse, AVG, and L/R/C/R)

$\bar{M}$ can be user defined with a drop down GUI or by filling in a table:

Option 1



Option 2