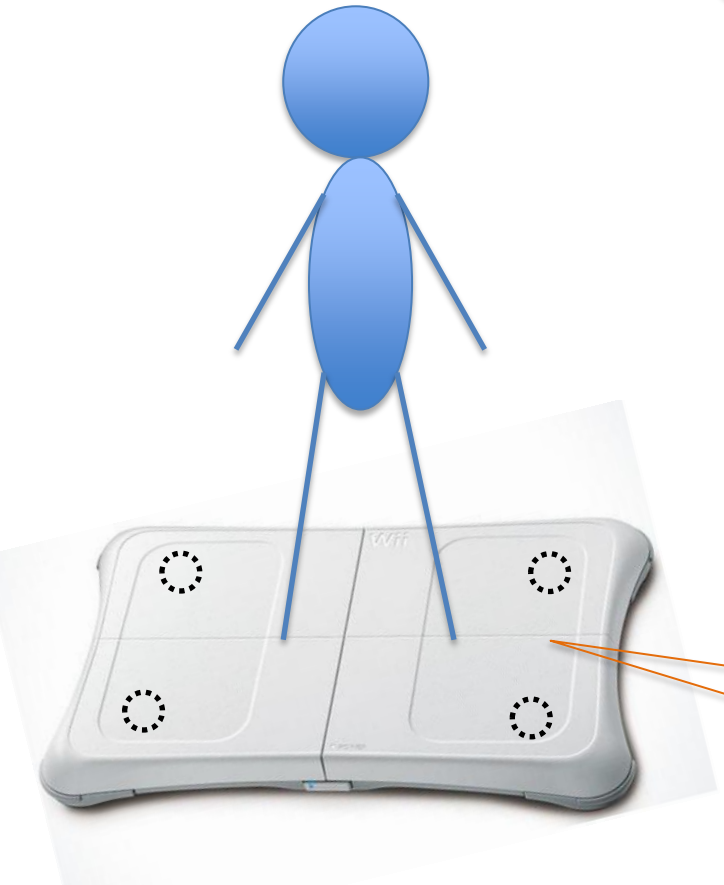
Kiwii Project

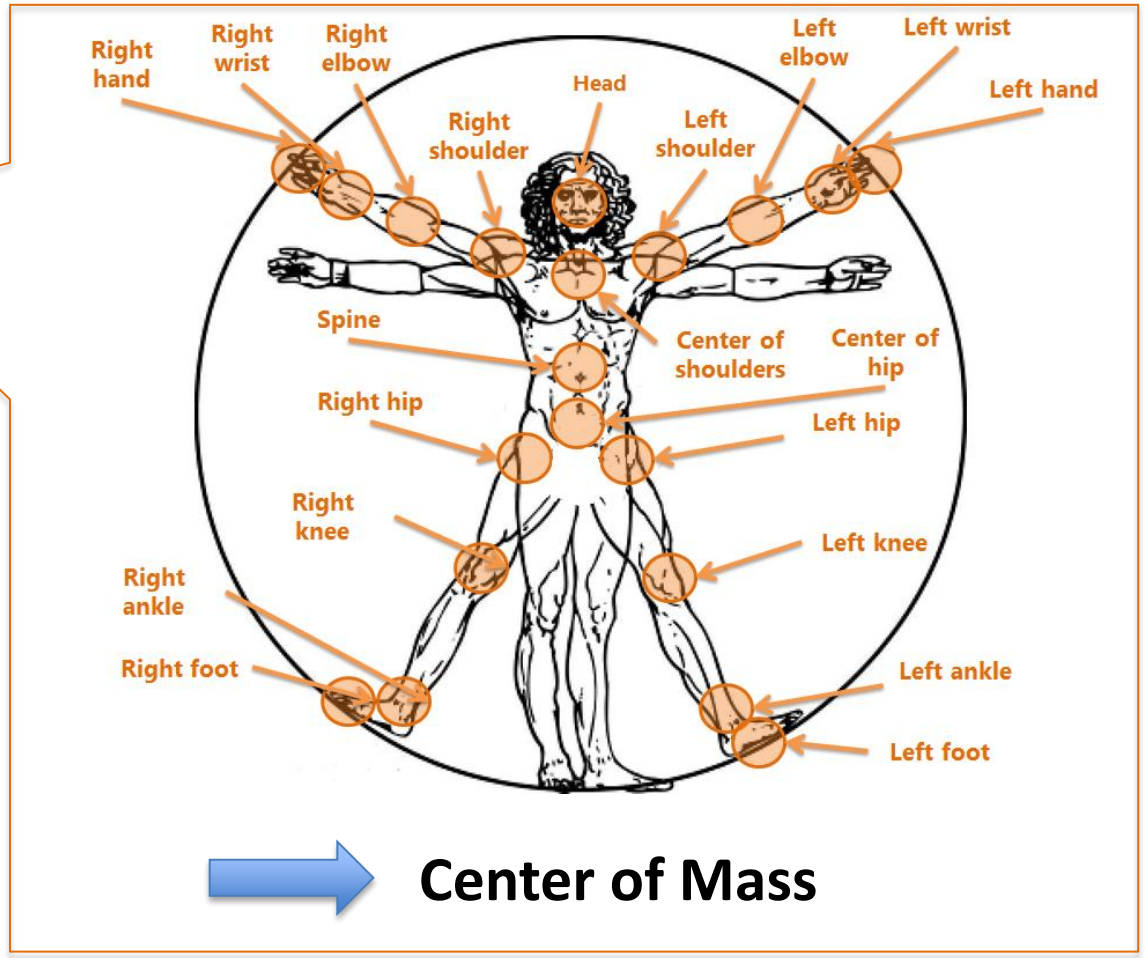
Kahori Kita
Yoshiyuki Sato
John Rocamora
Frank Schumann
Scott Yang

Motivation

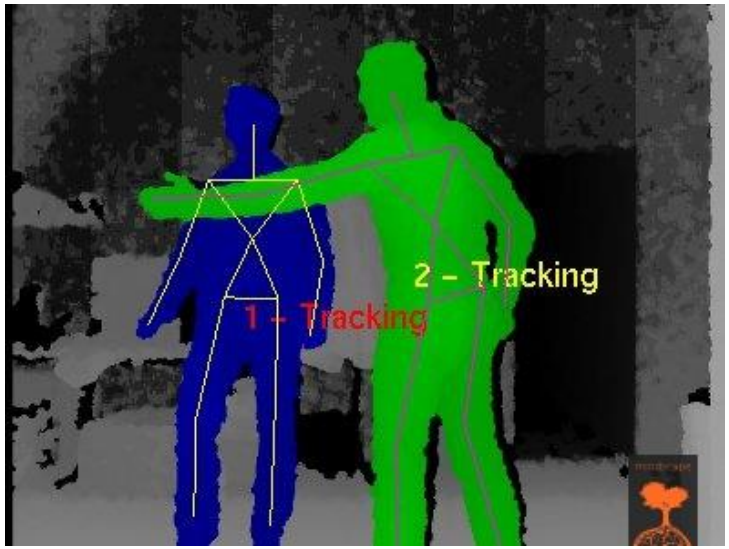
- Which joints are more important for balancing?
- Is vision or proprioception more important for balancing?

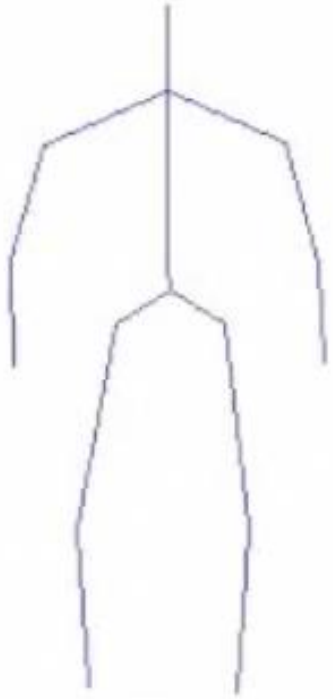
Setup



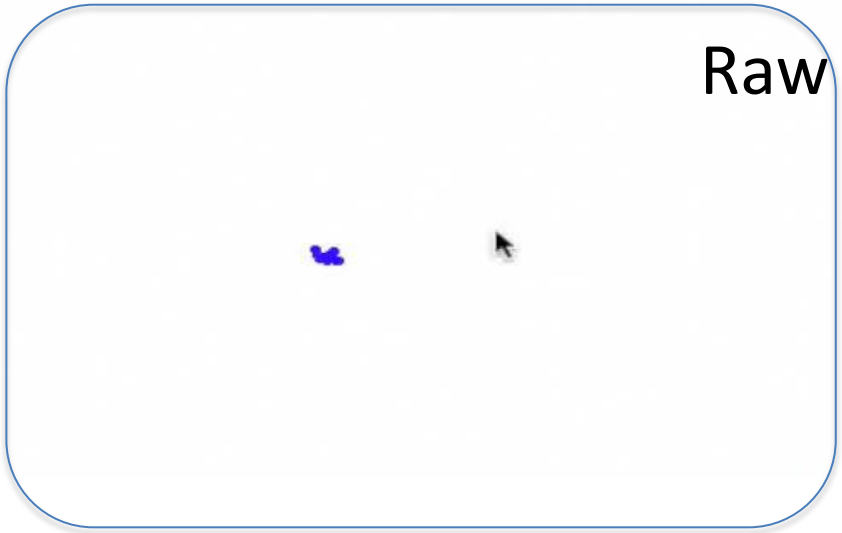


Center of Pressure



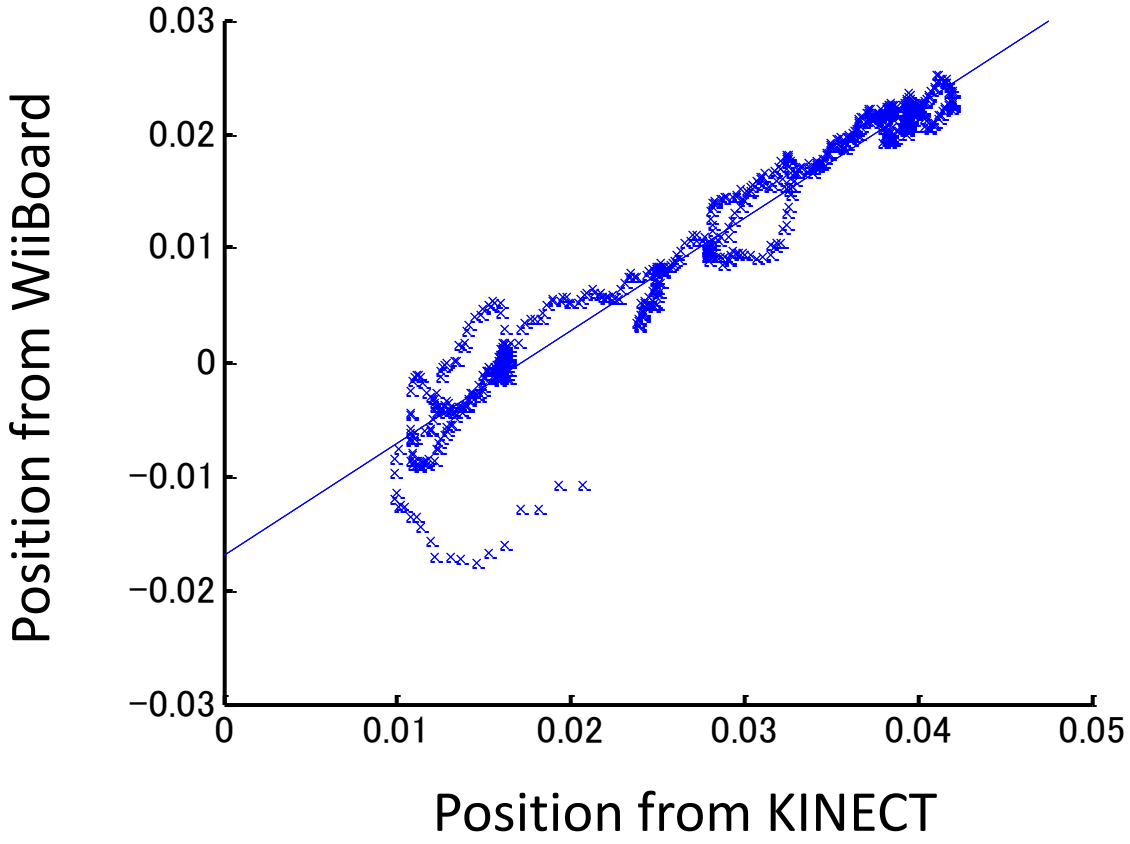


Raw KINECT data



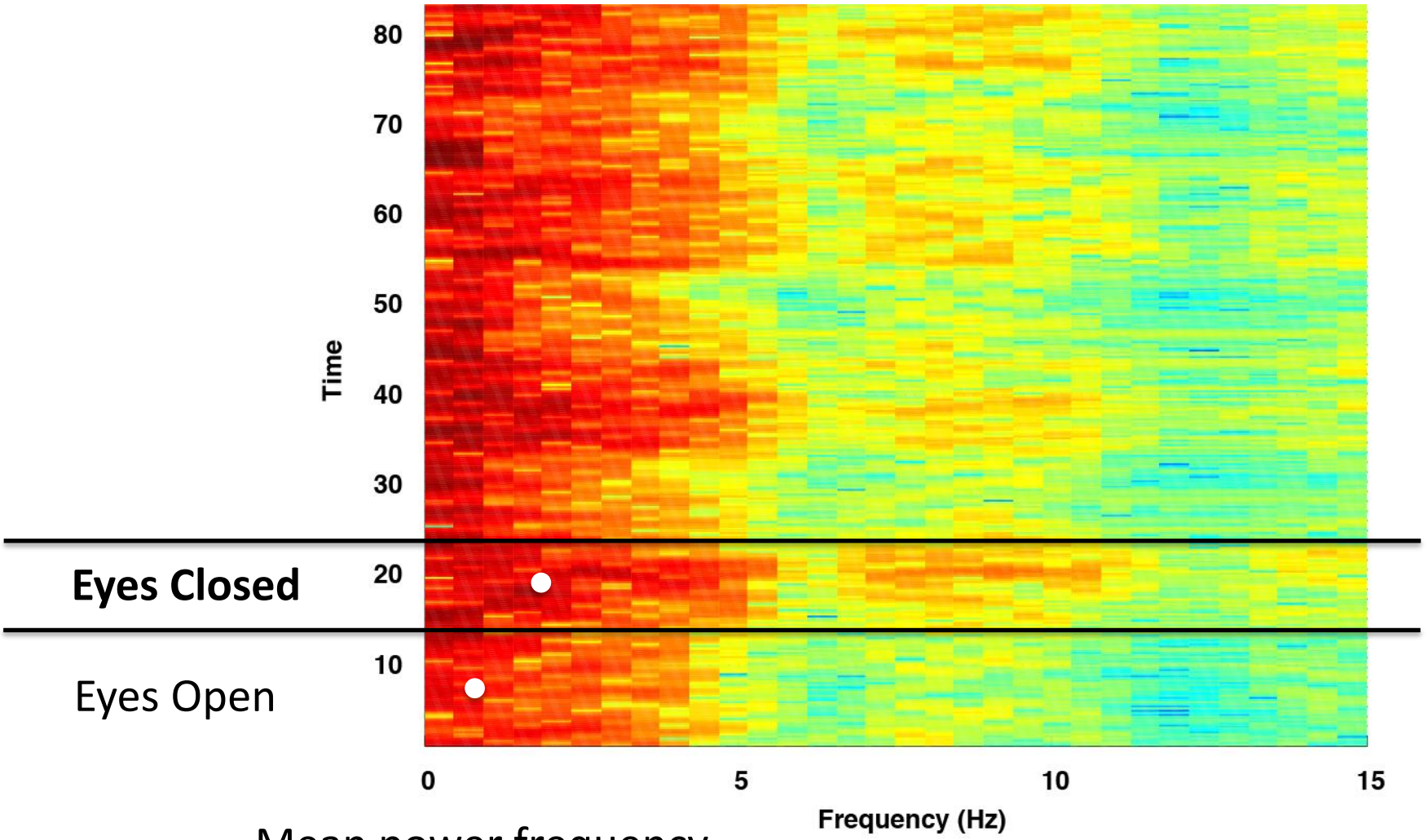
Raw Wii data

Calibration



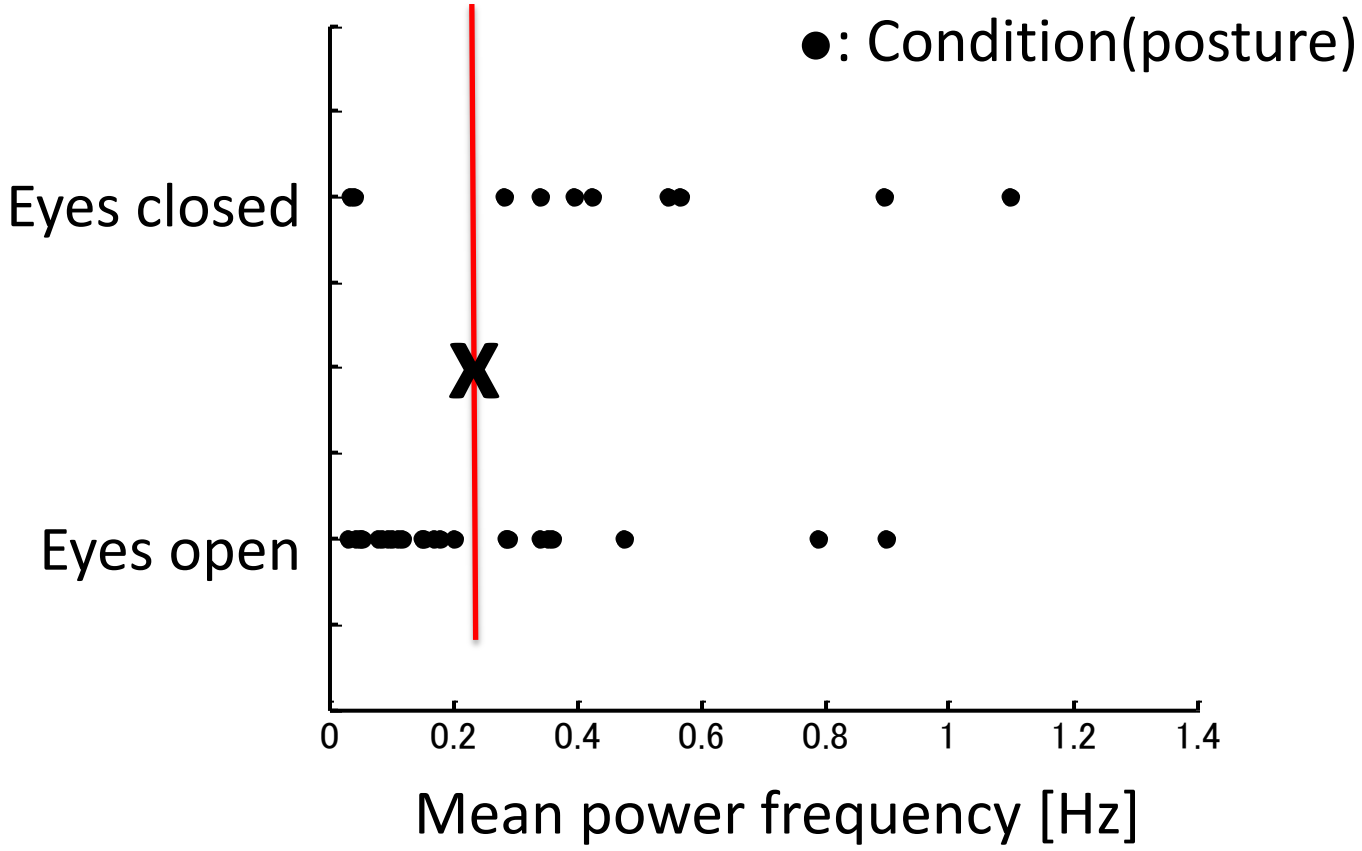
slope = 0.97

Spectrogram of Center of Pressure (Wii)



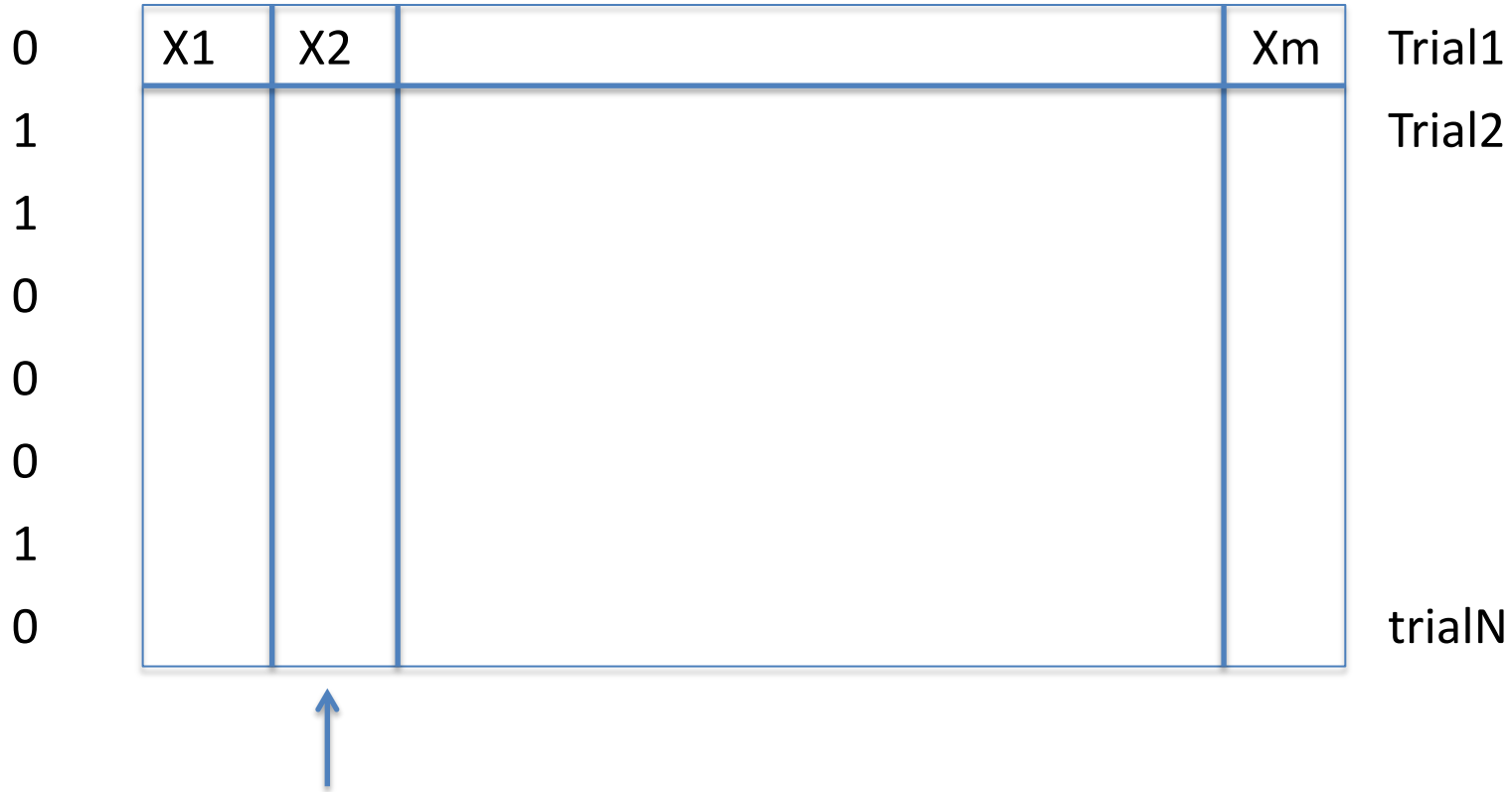
Mean power frequency

MPF of CoM(Wii) - eyes open/eyes closed

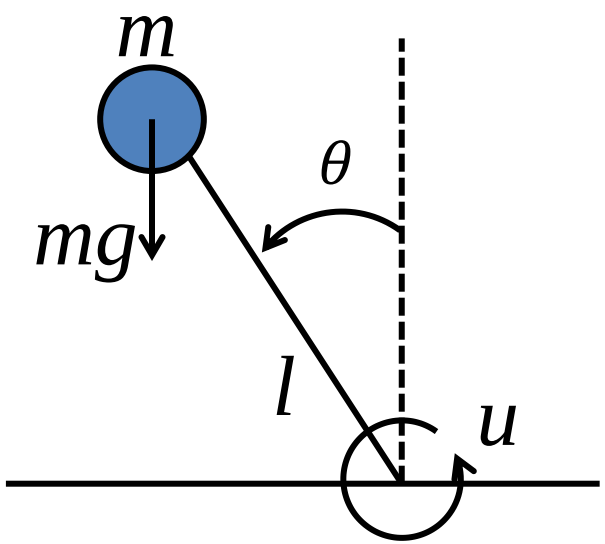


But the classification across postures is not trivial.

Classify Eye‘s Open / Closed



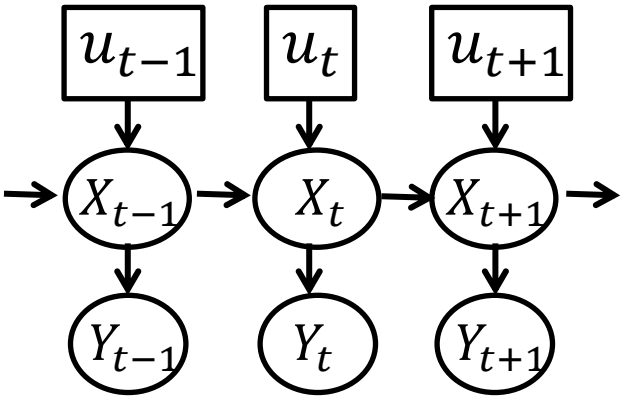
Kalman filter & LQR



$$ml^2\ddot{\theta} \simeq mgl\,\theta + u$$

state $X = \begin{bmatrix}\theta \\ \dot{\theta}\end{bmatrix}$

observation of θ $Y = \begin{bmatrix}y_{vis} \\ y_{pro}\end{bmatrix}$



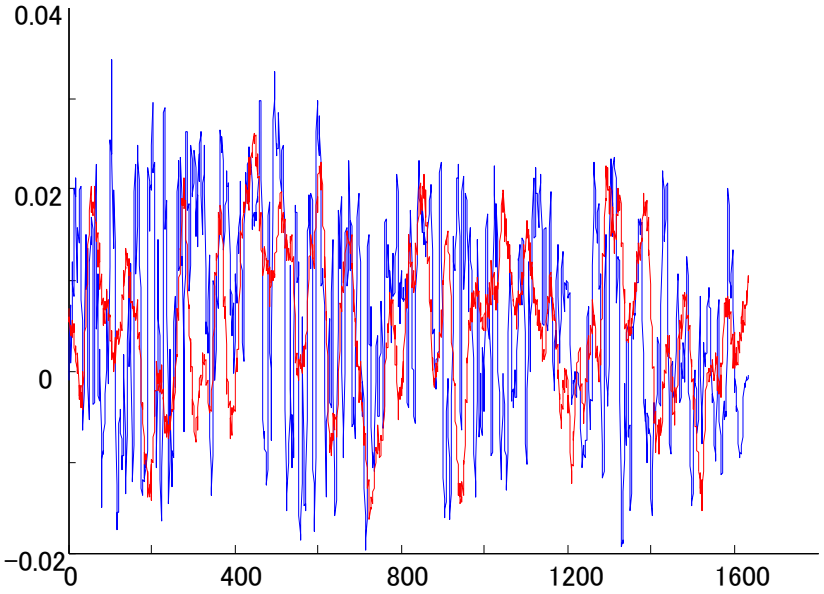
$$X_t = \begin{bmatrix}1 & \Delta t \\ \frac{g}{l}\Delta t & 1\end{bmatrix} X_{t-1} + \begin{bmatrix}0 \\ \frac{\Delta t}{ml^2}\end{bmatrix} u_{t-1} + w_t \qquad w_t \sim N(0, \begin{bmatrix}0 & 0 \\ 0 & \sigma^2_{motor}\end{bmatrix})$$

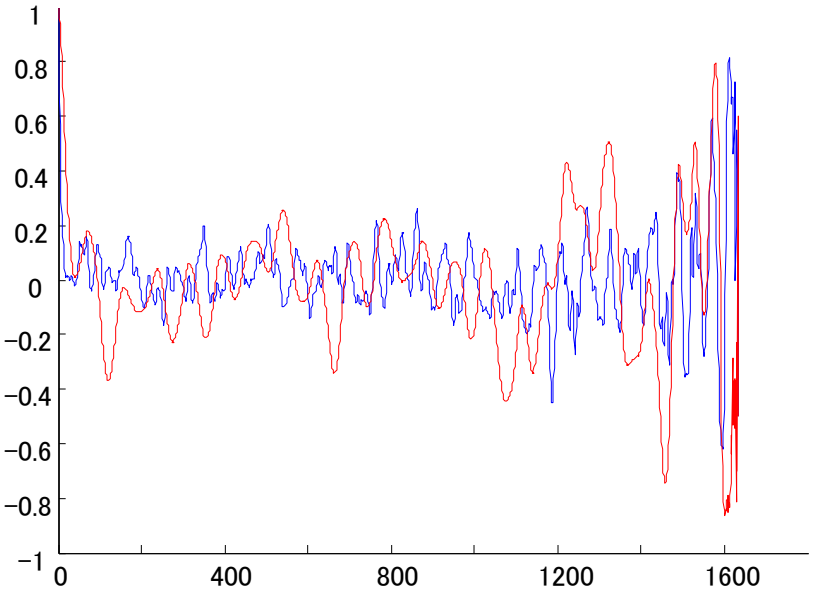
$$Y_t = \begin{bmatrix}1 & 0 \\ 1 & 0\end{bmatrix} X_t + v_t \qquad v_t \sim N(0, \begin{bmatrix}\sigma^2_{vis} & 0 \\ 0 & \sigma^2_{pro}\end{bmatrix})$$

Center of mass

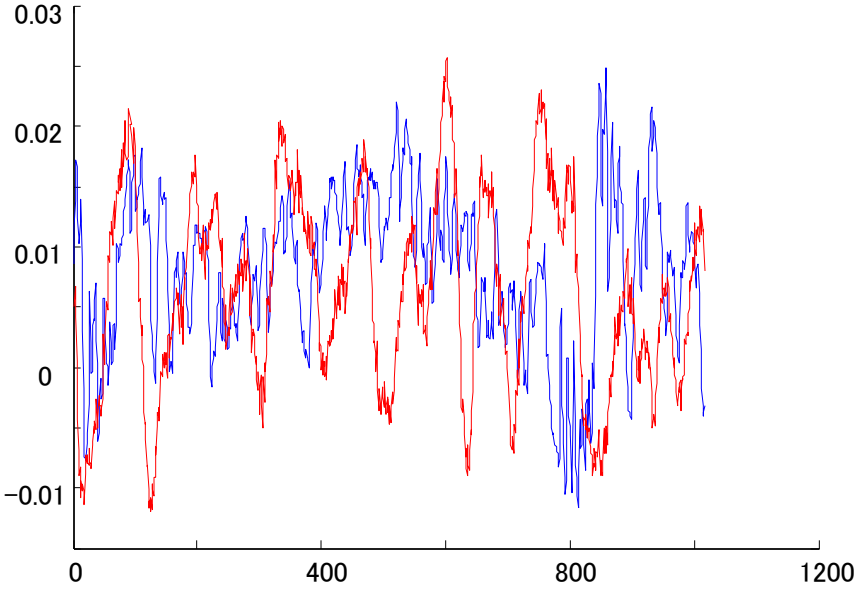
Auto-correlation

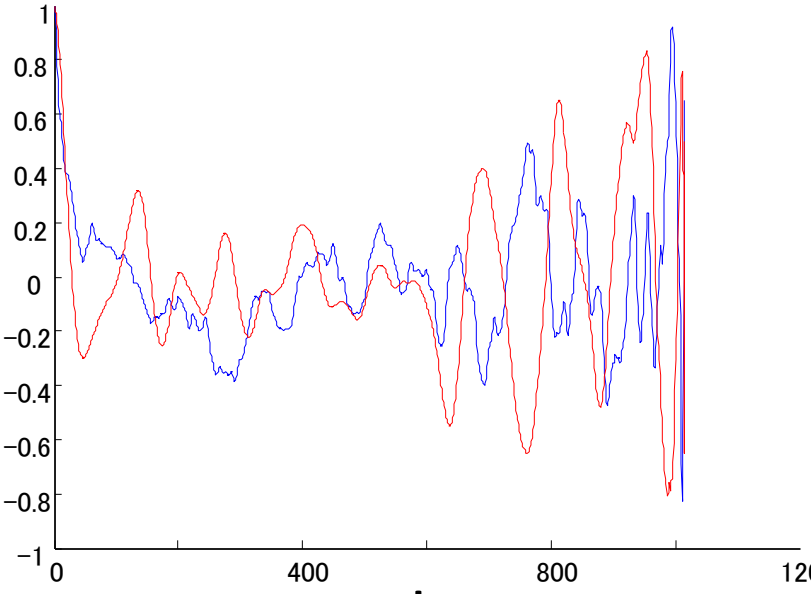
eyes closed





eyes open





Time

Delay

Conclusion

- Which joints are more important for balancing?
- Is vision or proprioception more important for balancing?

Thank

You!