SMIL

Connecting the Brain to the Body
from Molecules to Complex Social Behaviors

Lecture 1 – Part II
The Study of Social Behaviors

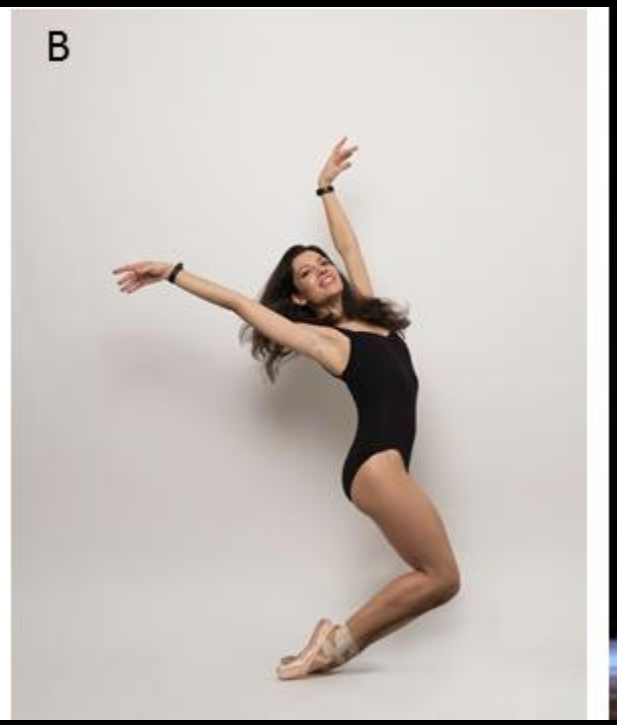
An example from the Performing Arts

Class Objectives

- Learn about natural behaviors from a biorhythmic perspective
- Learn about levels of behavioral description and their applications
- Translate existing methods in brain science to behavioral science
- Learn about biosensors
    1. What types of wearable biosensors are out there at our reach
    2. What are some caveats
    3. How to scale their use from lab basic science to e.g. 10K+ users

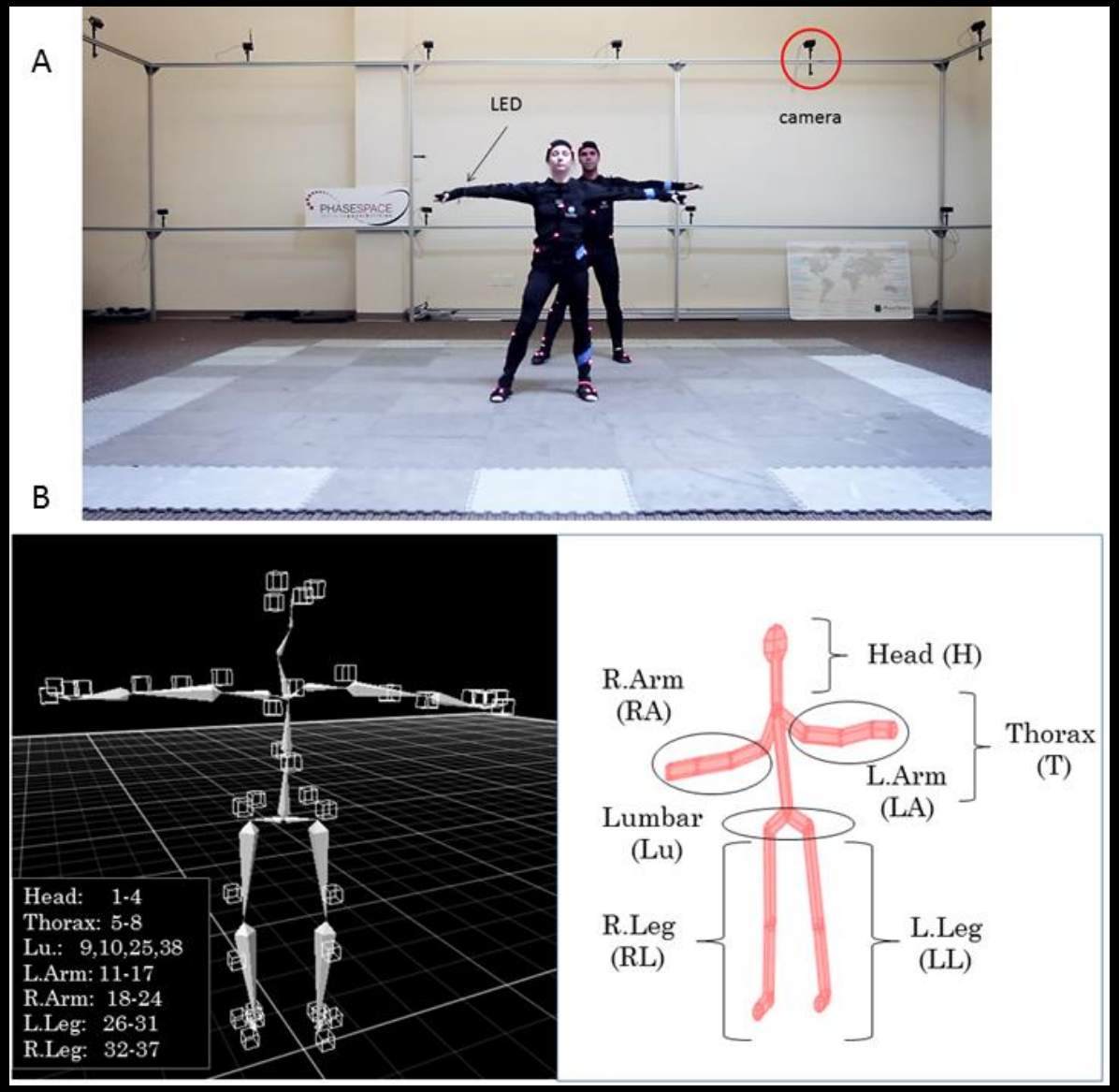
Digital Ballet: An example of the use of active marker camera systems in the Performing Arts

Partnering Dance as Complex Dynamical Systems: Creating a New Language to Represent and Synthetize Ballet Routines

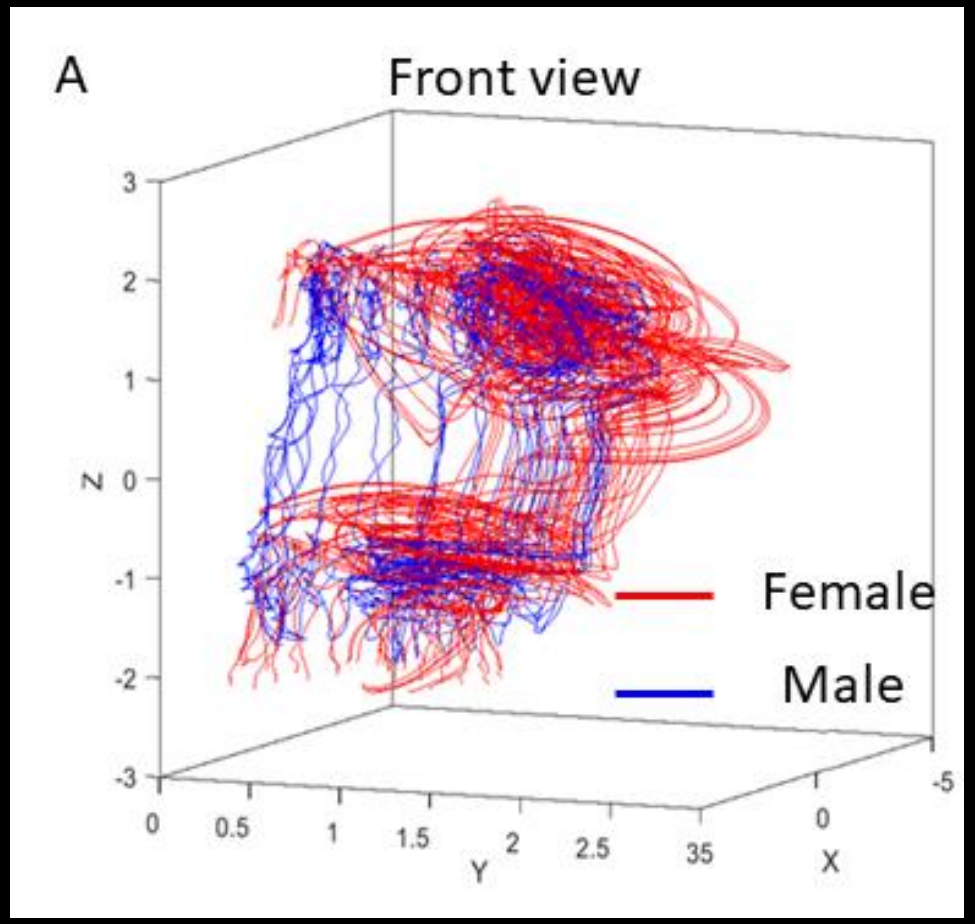


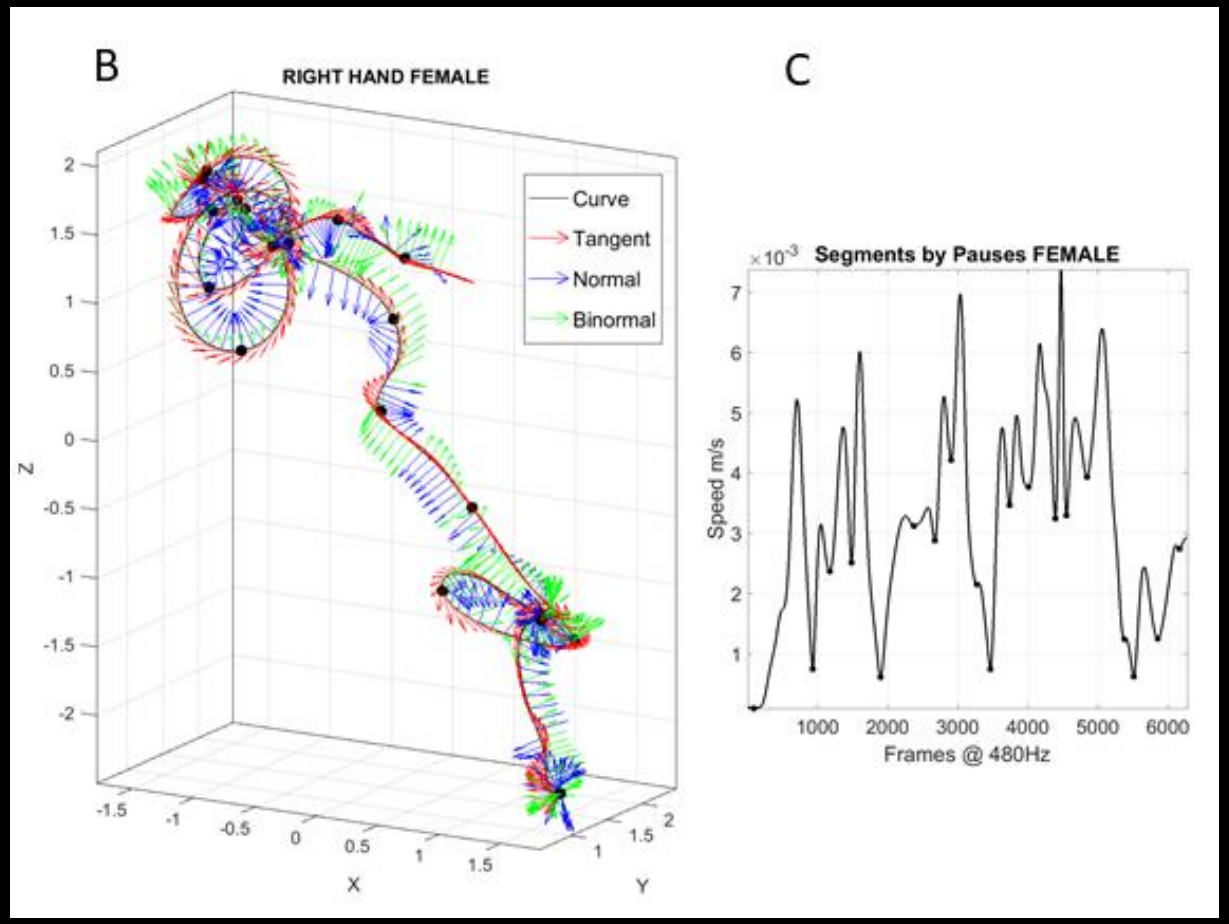
Dr. Vilelmini Kalampratsiduo

Calibration and Data Acquisition



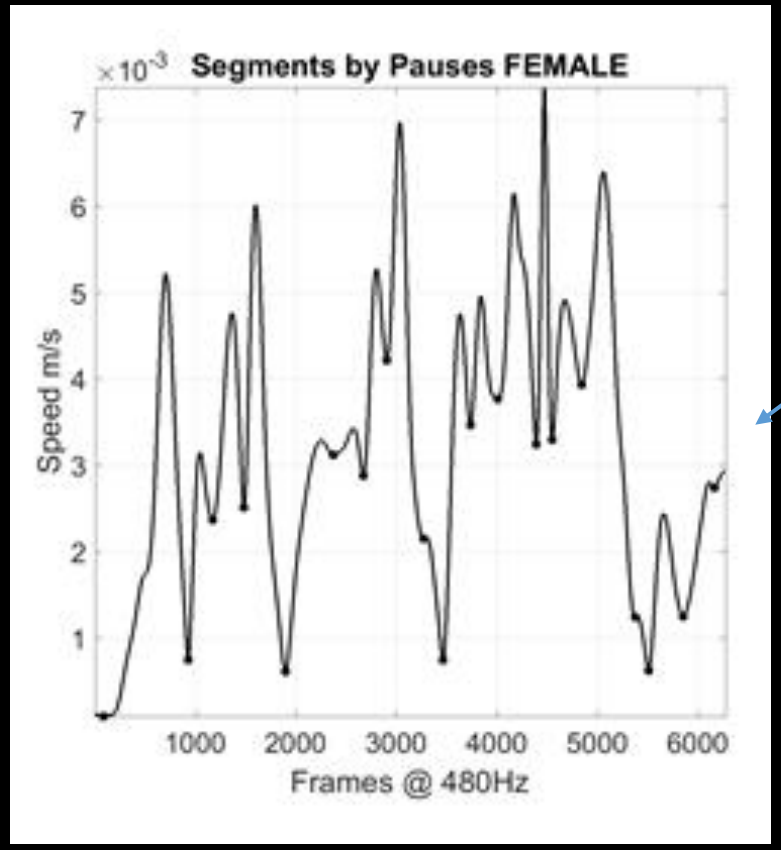
Complex Trajectories: Geometry vs. Dynamics



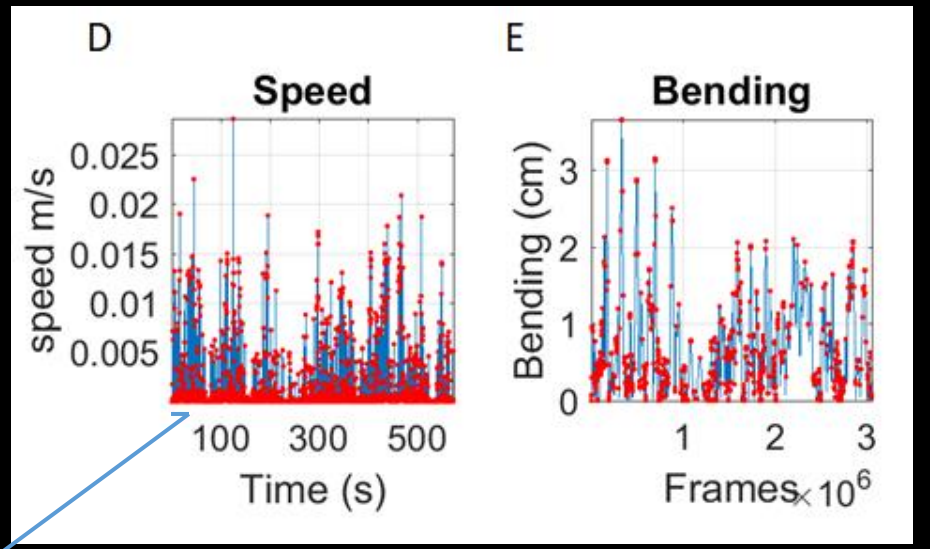


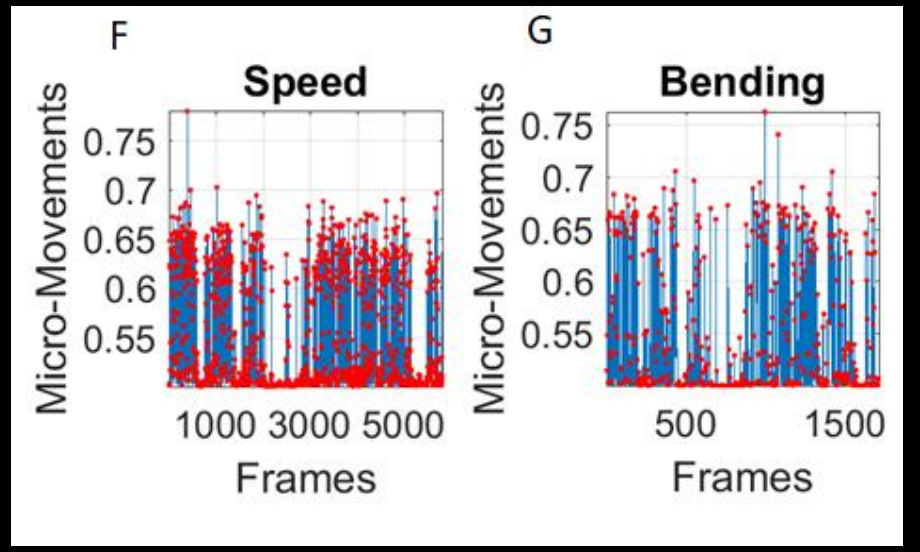
Synthetize New Data Types

$$MMS_{peak} = \frac{\max}{\max + Average_{\min to \min}}$$

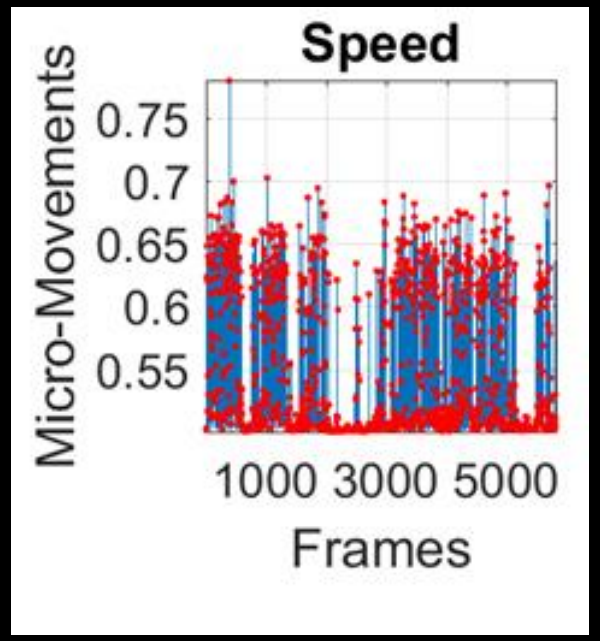


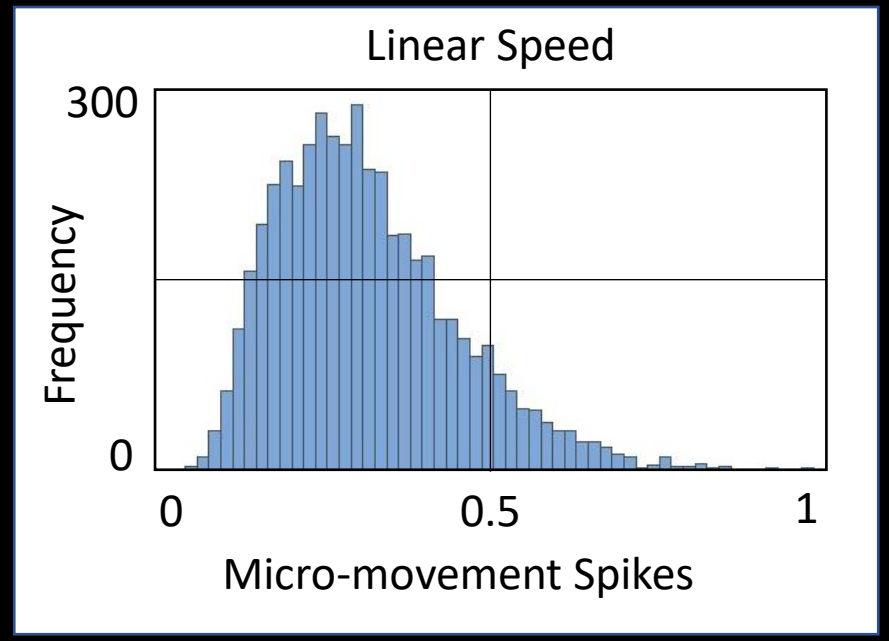
12.5 seconds



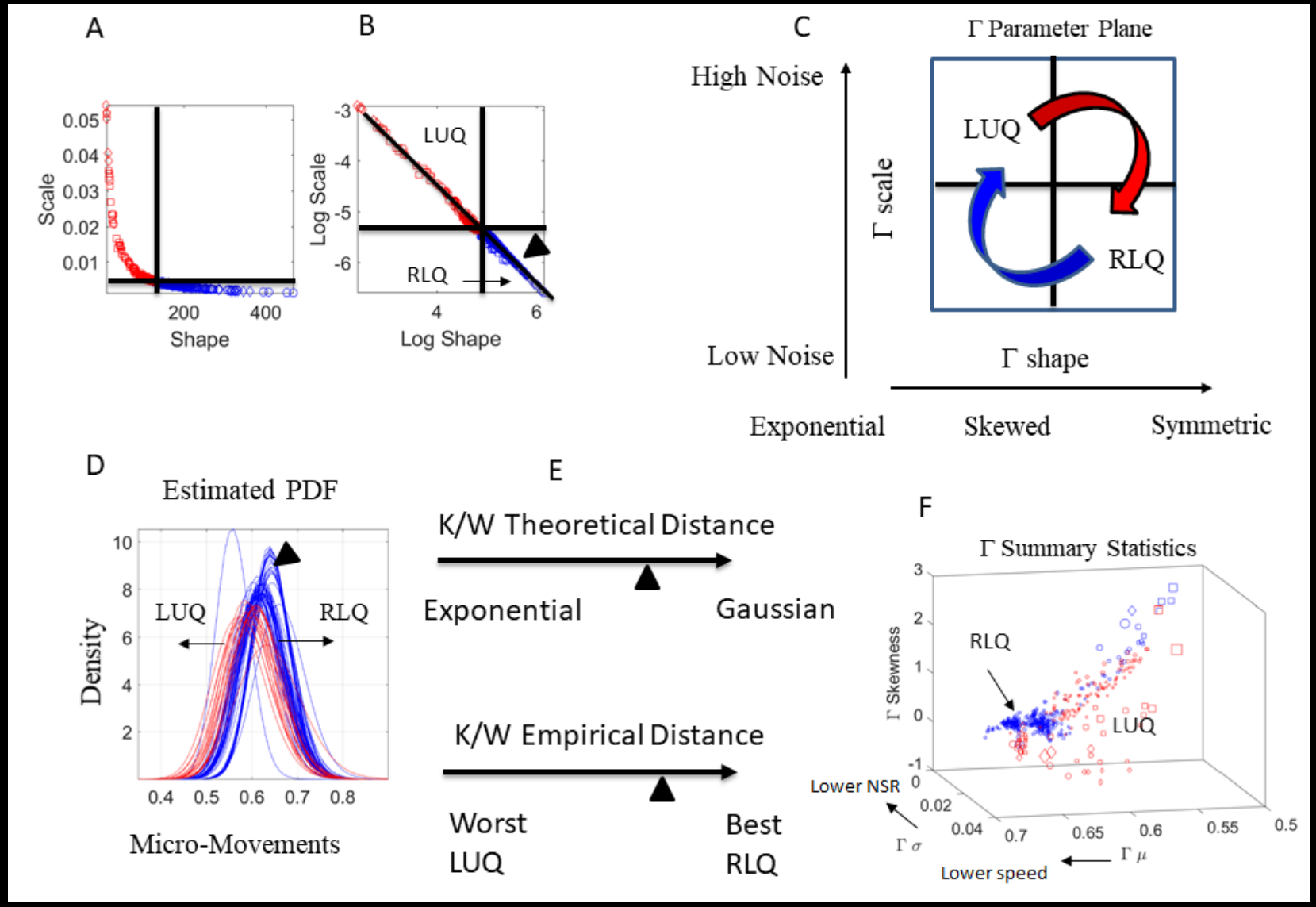


What other biorhythms can we use to study social interactions?

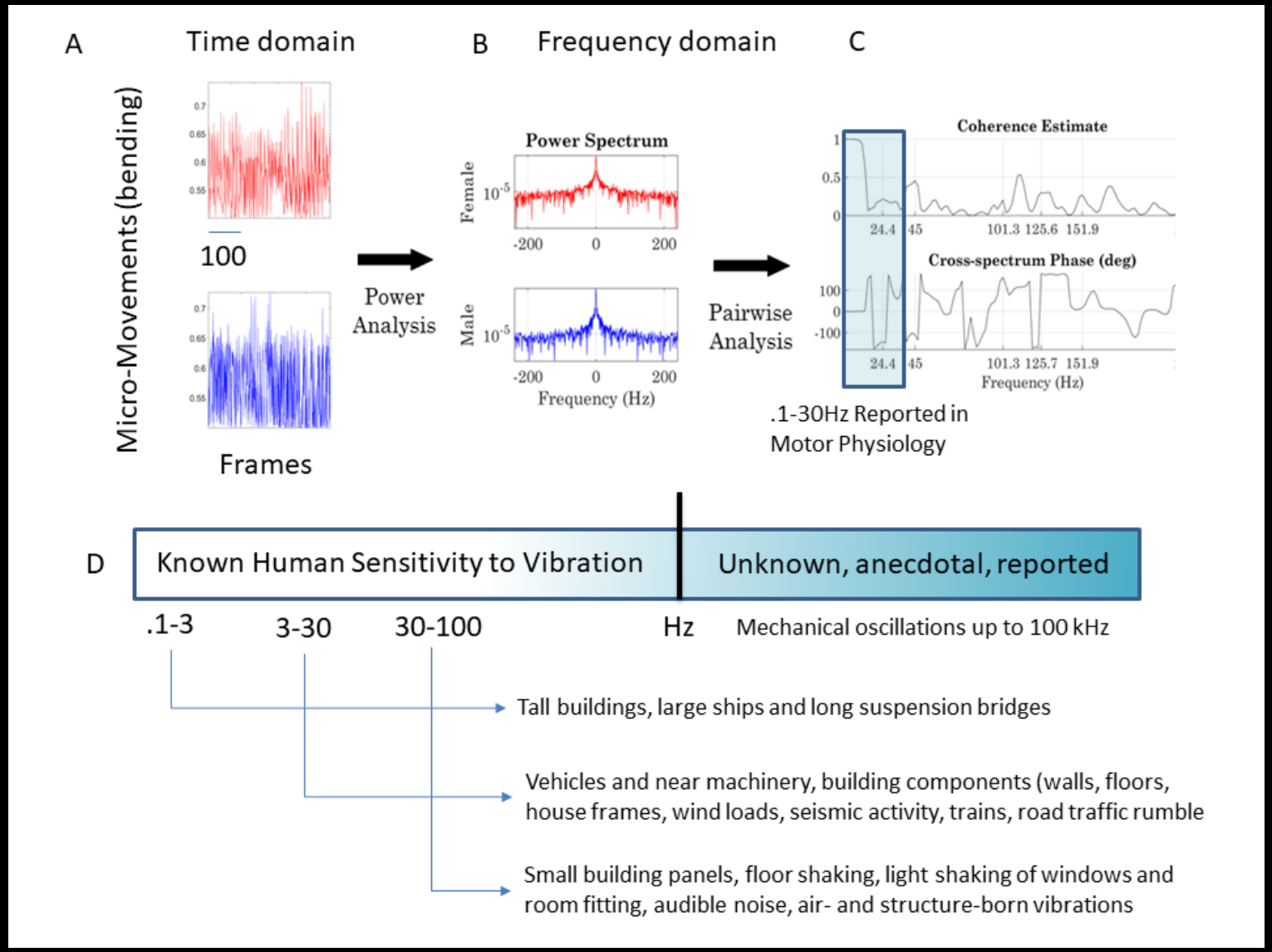




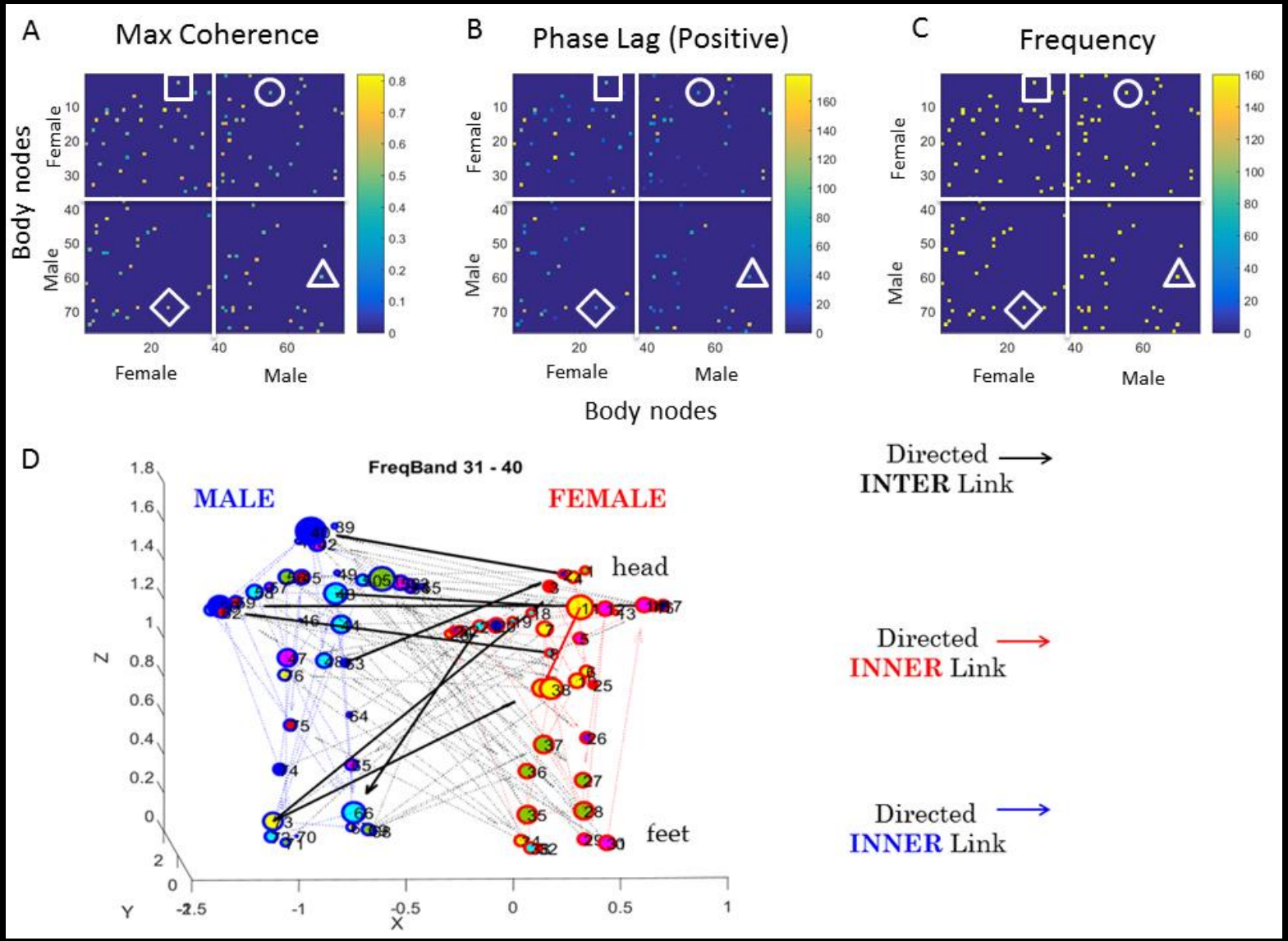
Stochastic Signatures Estimation



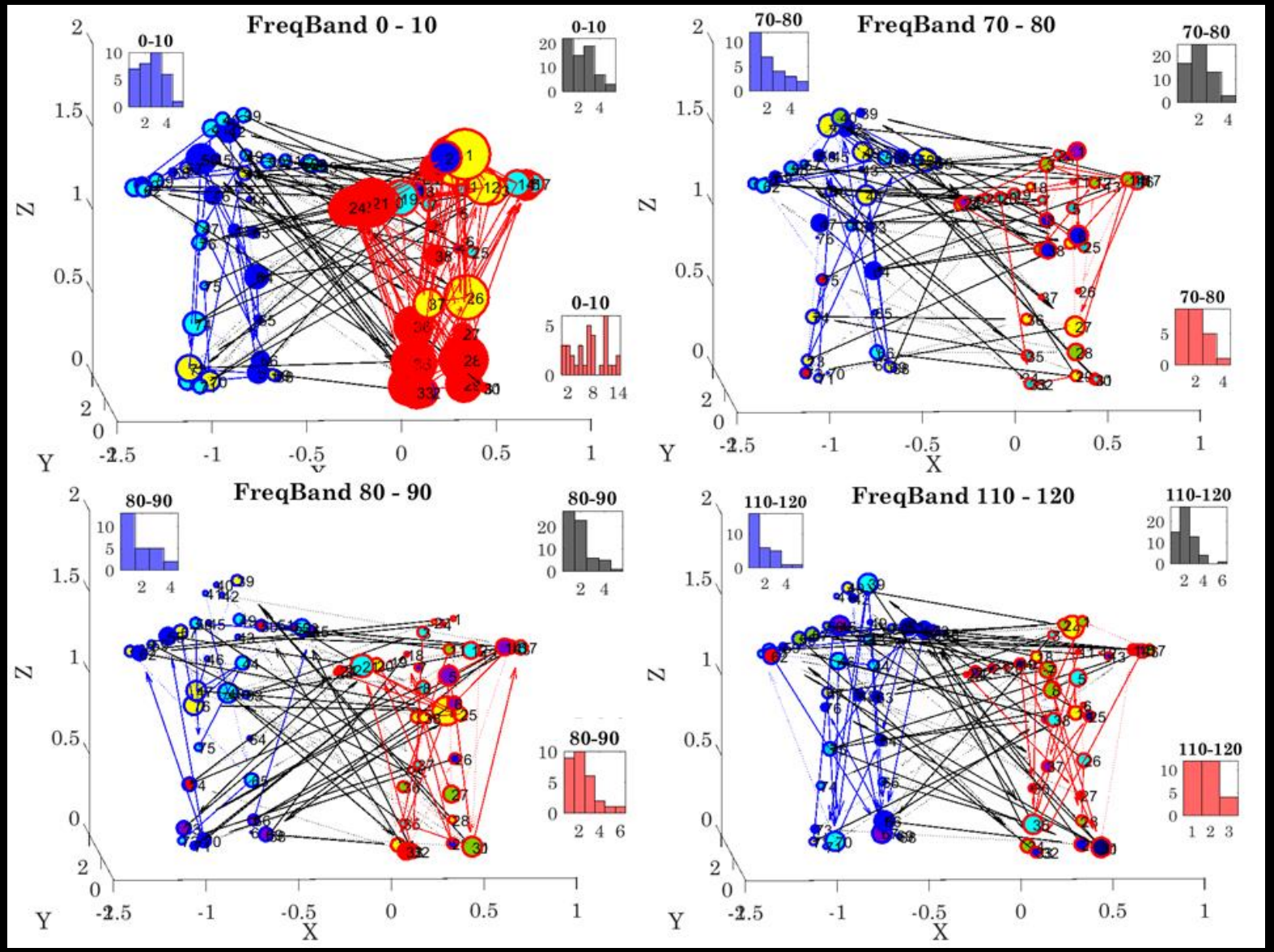
MMS as Vibrations: Pairwise Cross-Coherence Phase Analyses



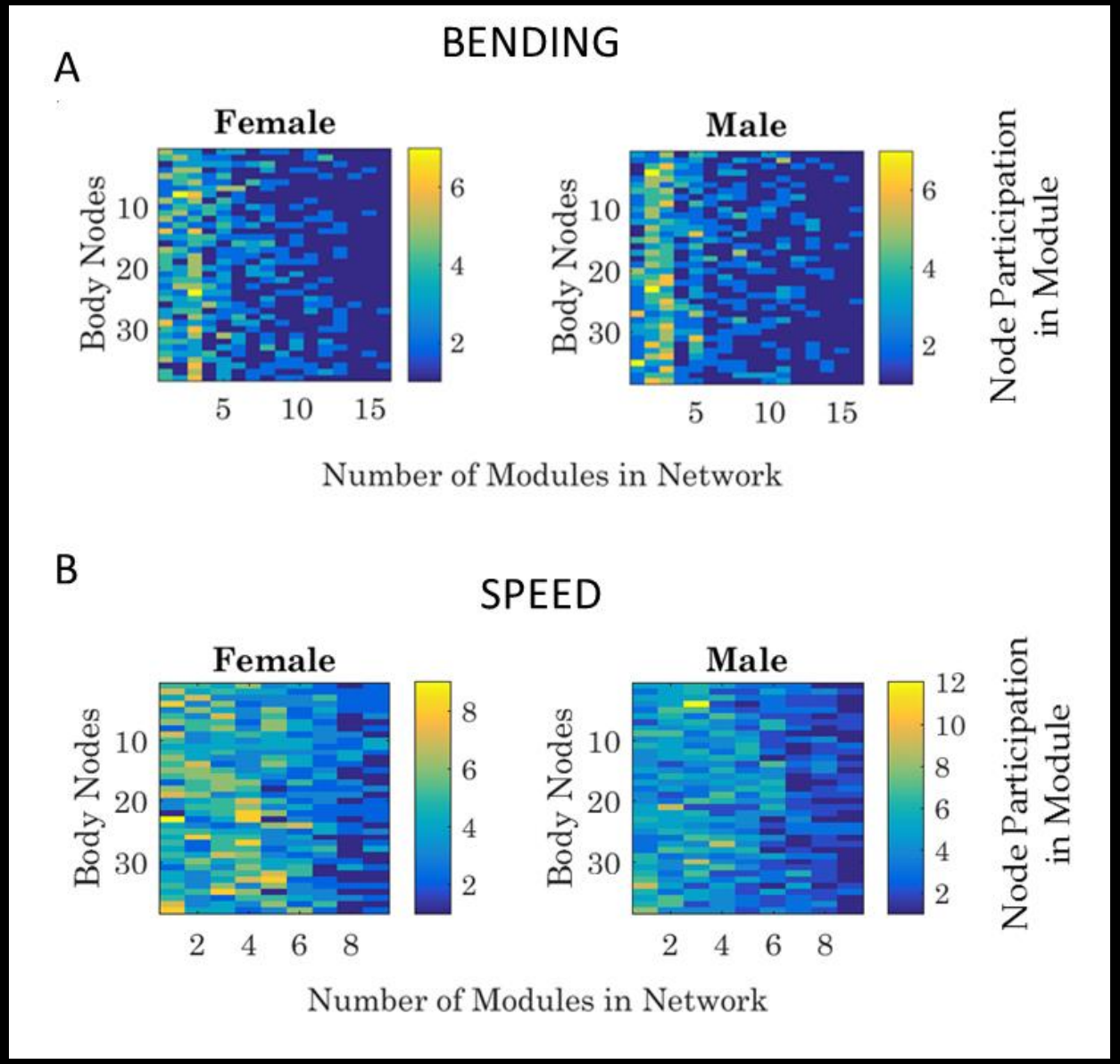
Frequency Domain Parameterization and Network Connectivity



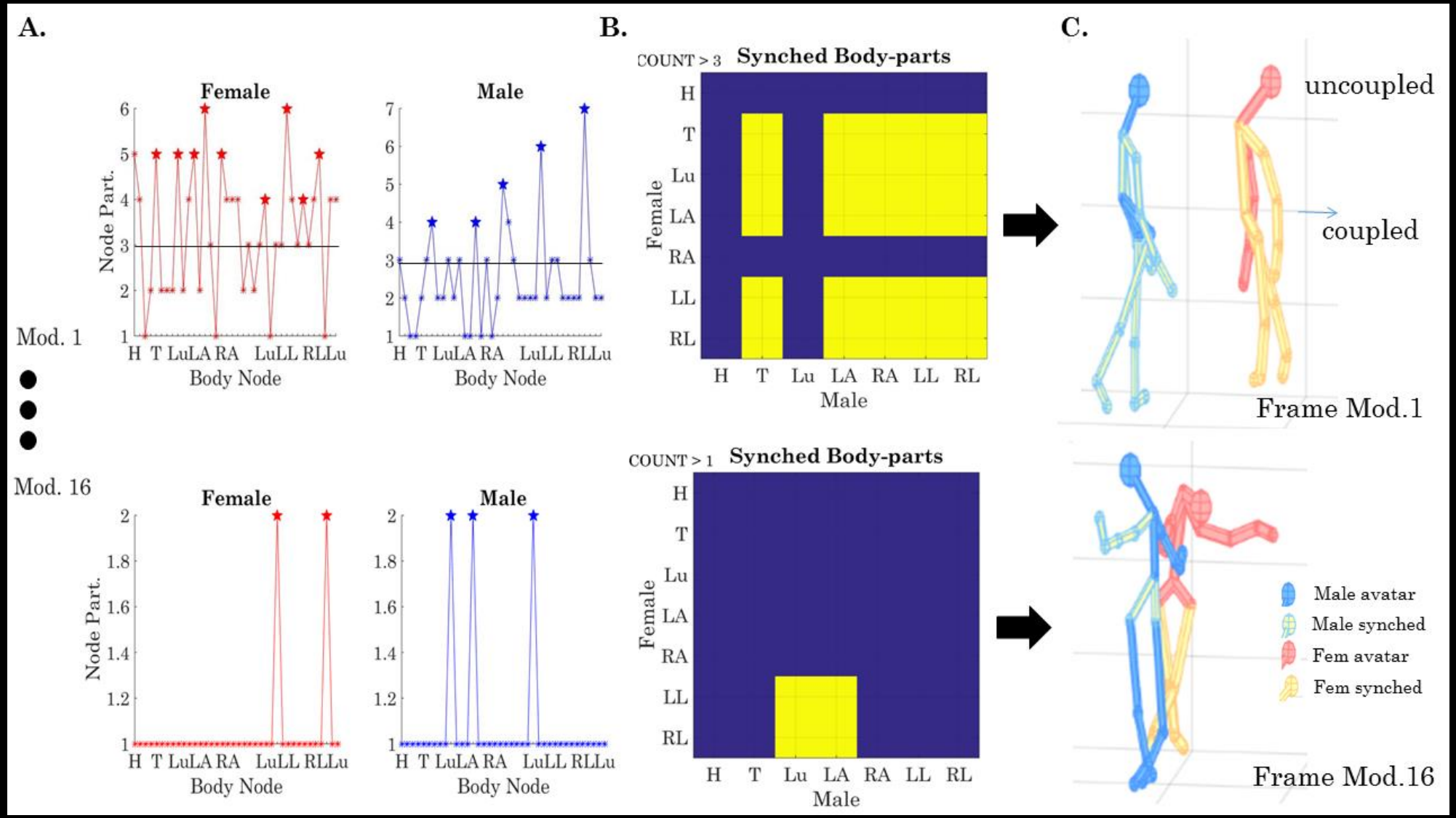
Information Transmission Across Frequency Bands



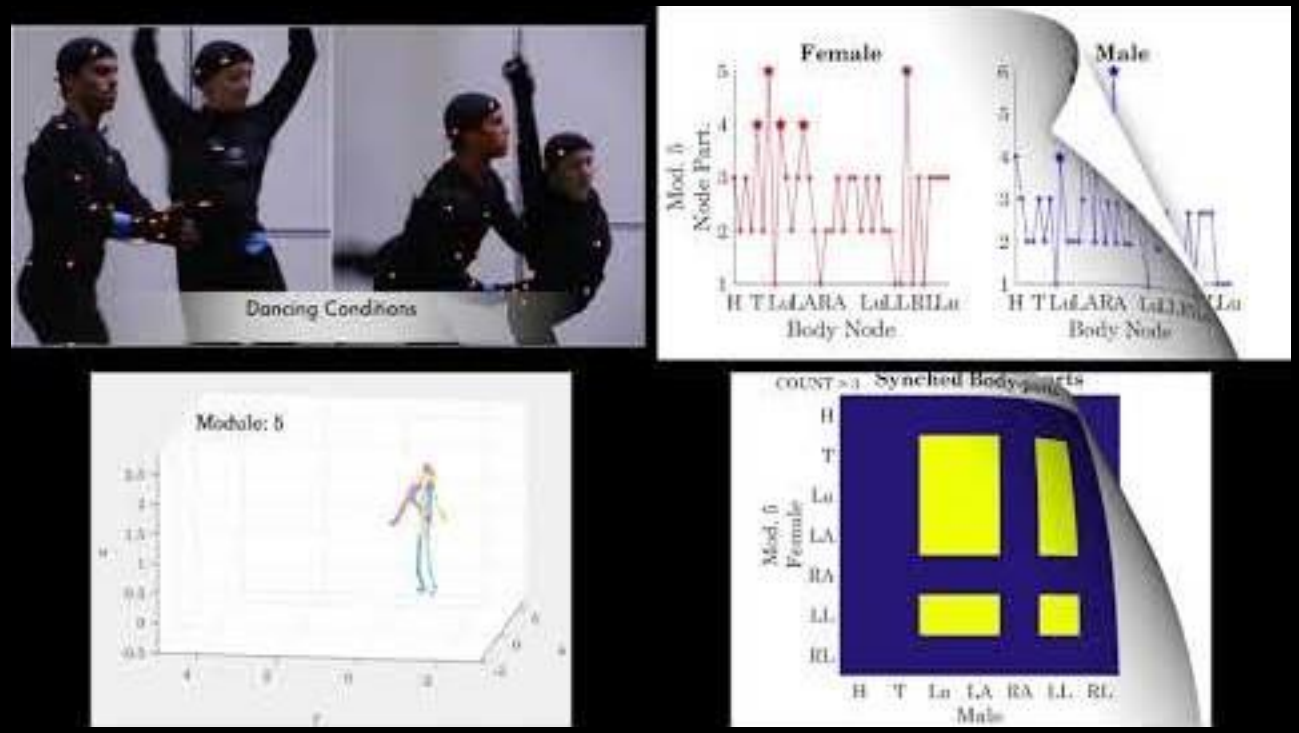
Modularity and Node Participation in Module



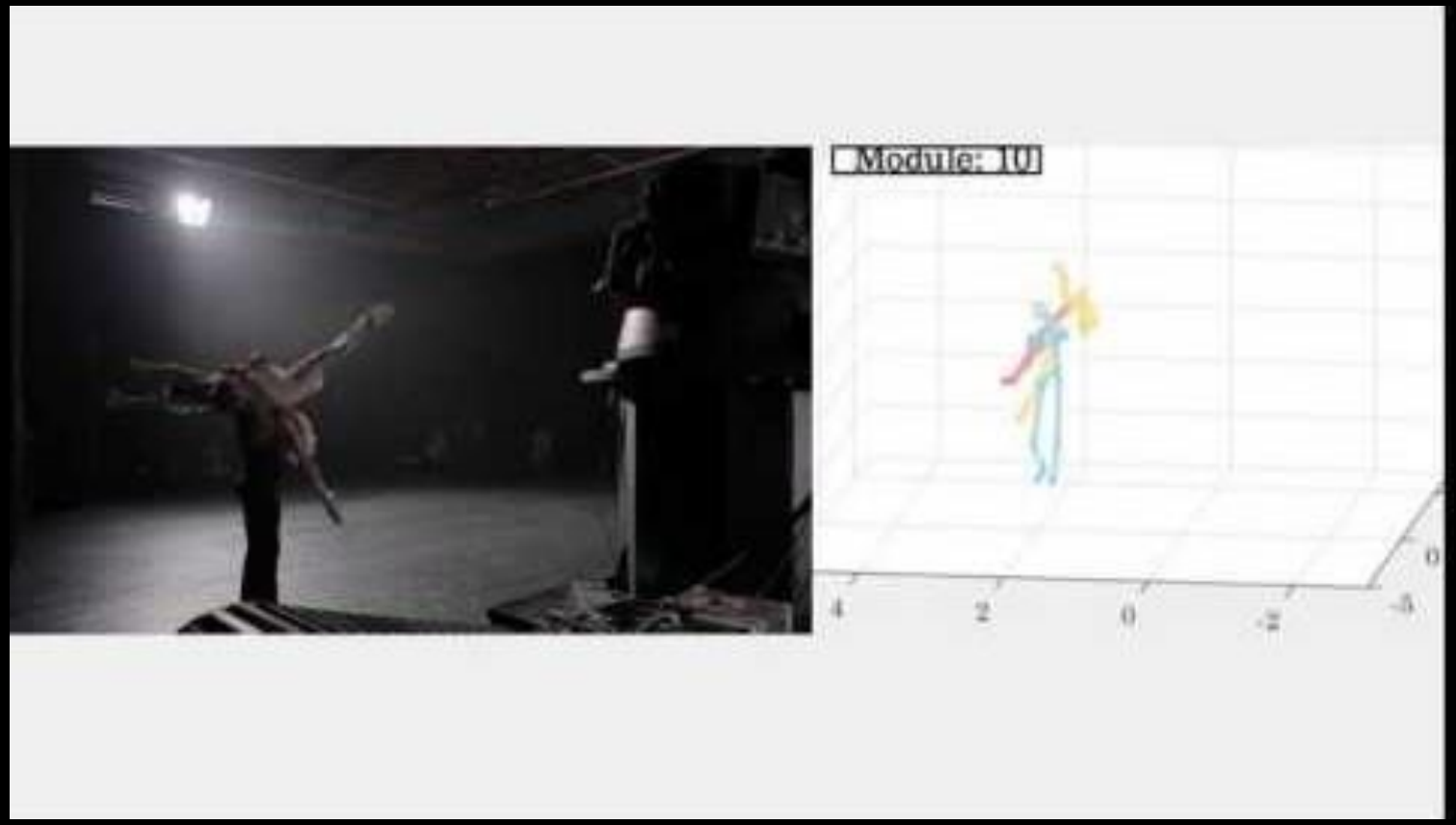
Creating a New Language to Describe Choreographies



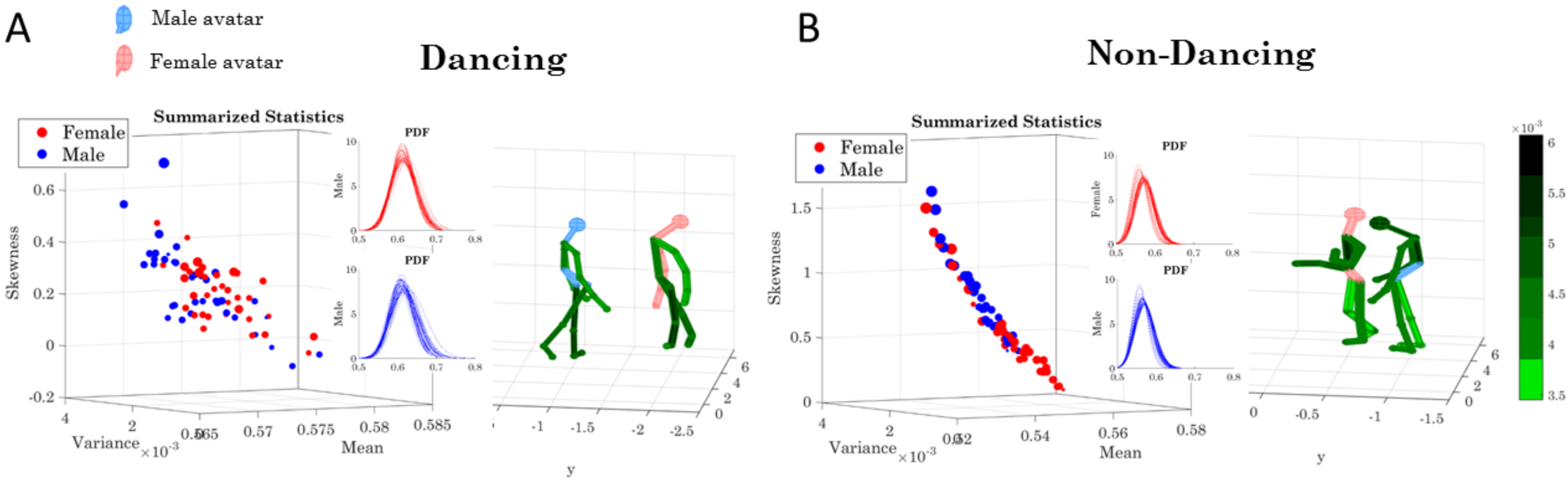
Integration of Macro- and Micro-Levels of Behavioral Description



Real-Time Decoding of Cohesiveness



Bodily Maps of Noise to Signal Ratio



Kalampratsiduo & Torres, 2018

iPSCs – NPC
ASD vs Neurotypical Control

Collaborative work with James Millonig and Enmanuel DiCicco Bloom Labs

Postdoc Madeline Williams (Molecular Neuroscience)
Other contributors
Smrithi Prem, PhD;
Robert Connacher, PhD;
Xiaofeng Zhou
Paul Matteson, PhD

Cells used in the analyses

Figure 6: New Jersey Center of Excellence patient cohort

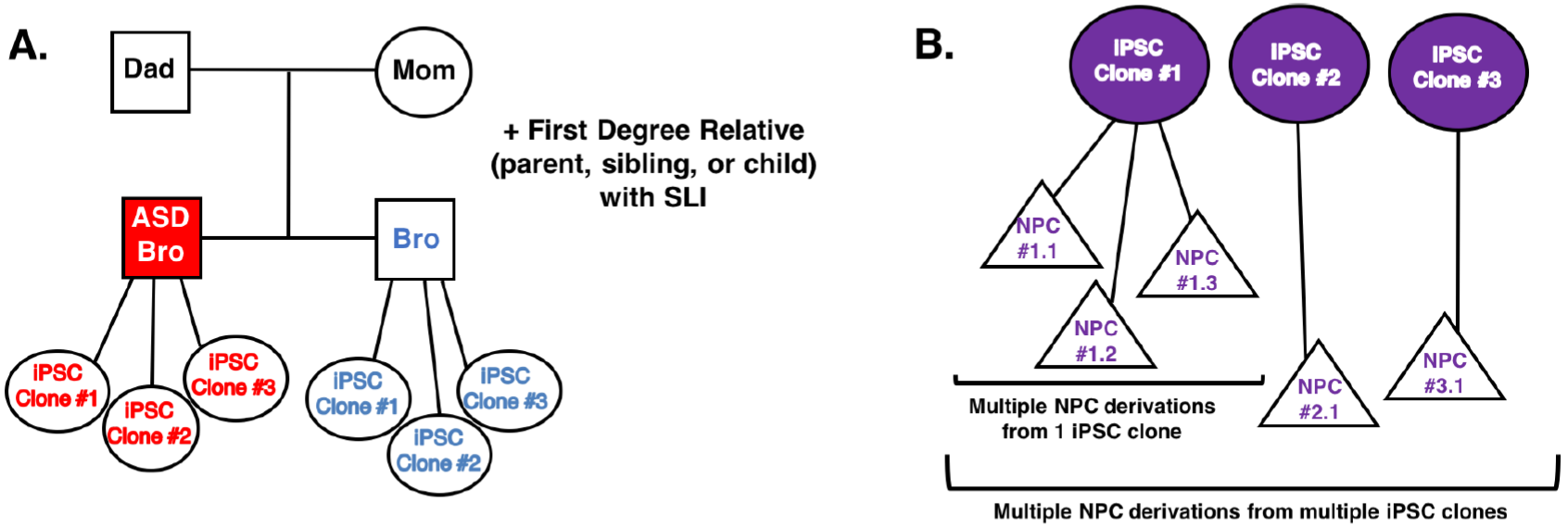


Figure 6: Two families were chosen from a larger cohort of New Jersey families that have 1st degree relatives with SLI, A) blood was drawn and iPSCs were created from a boy child with autism and his unaffected brother, B) in following studies between 2 and 5 iPSC clones were used to derive NPCs, in some cases multiple NPCs were derived from 1 iPSC clone.

Figure 19: Family 1 ASD NPCs exhibit a reduction in proliferation in comparison to sibling NPCs

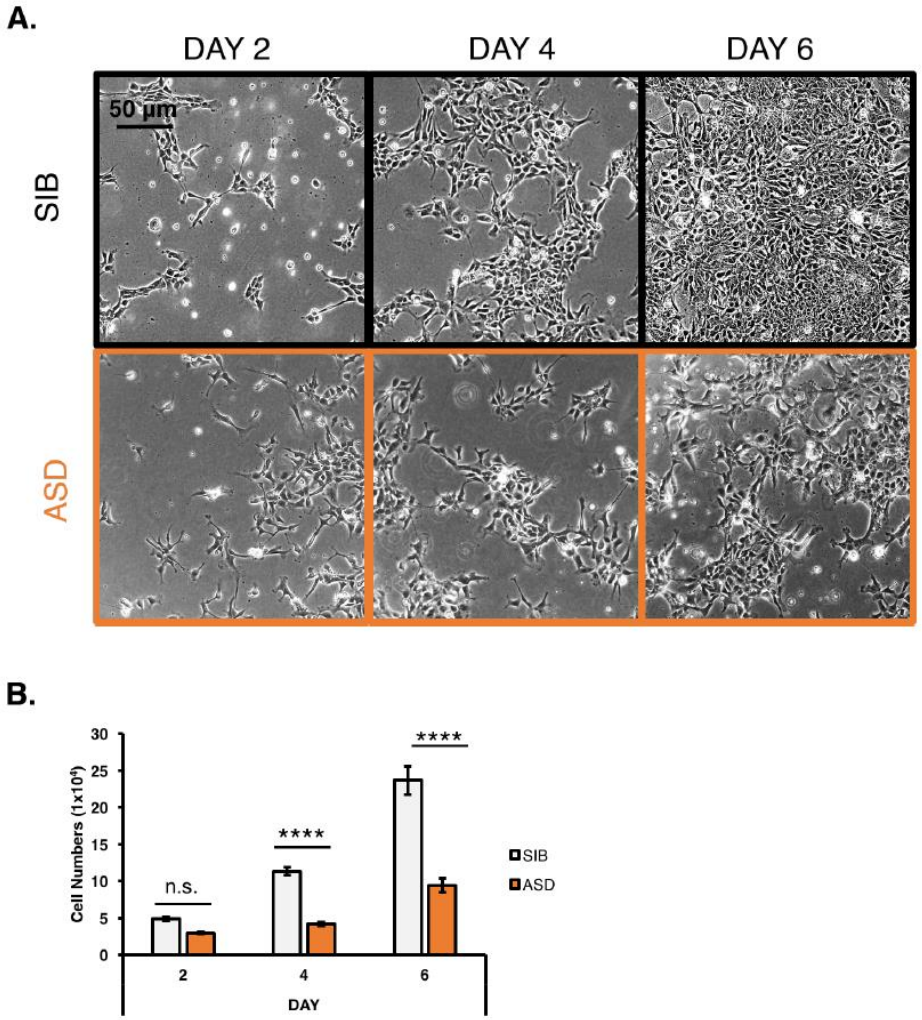


Figure 19 A) Representative image of SIB and ASD NPCs at days 2, 4, 6. B) Family 1: ASD NPCs display significantly reduced cell numbers at days 4 and 6 (****, p <0.0001, SIB n=4/5/18/39, ASD n=5/9/24/51; clones/NPC deriv/expt/wells).

Manual Count of cells

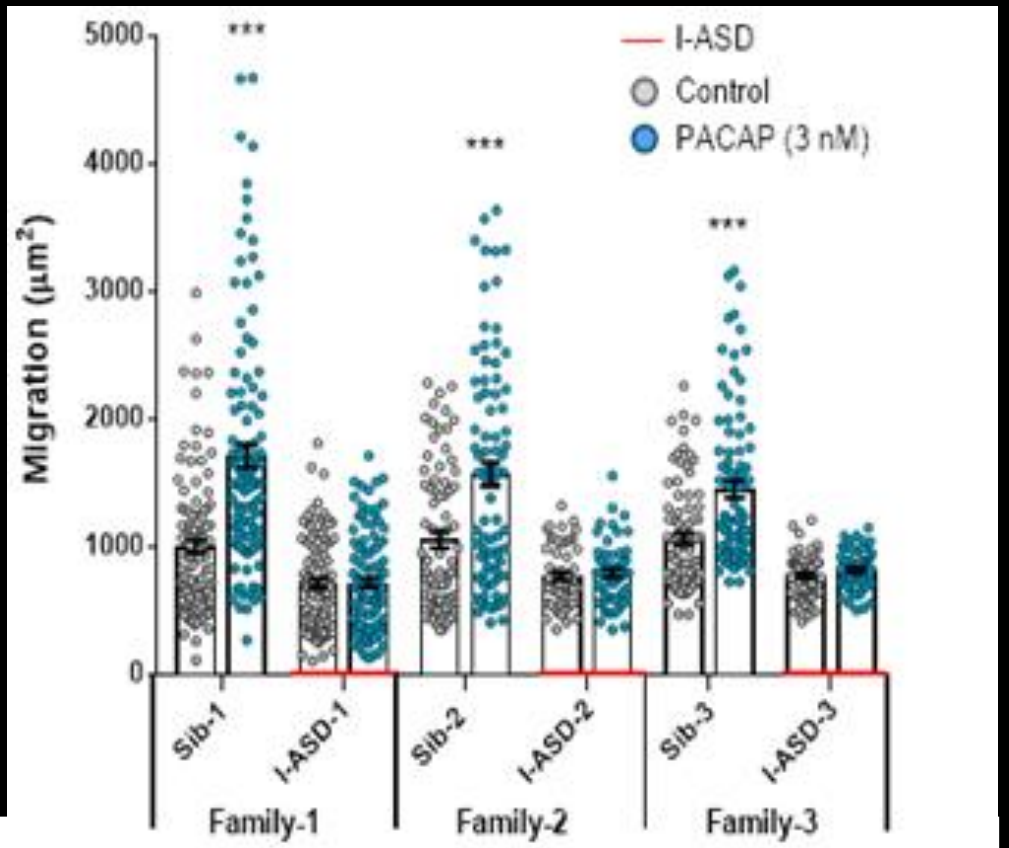
One size fits all model

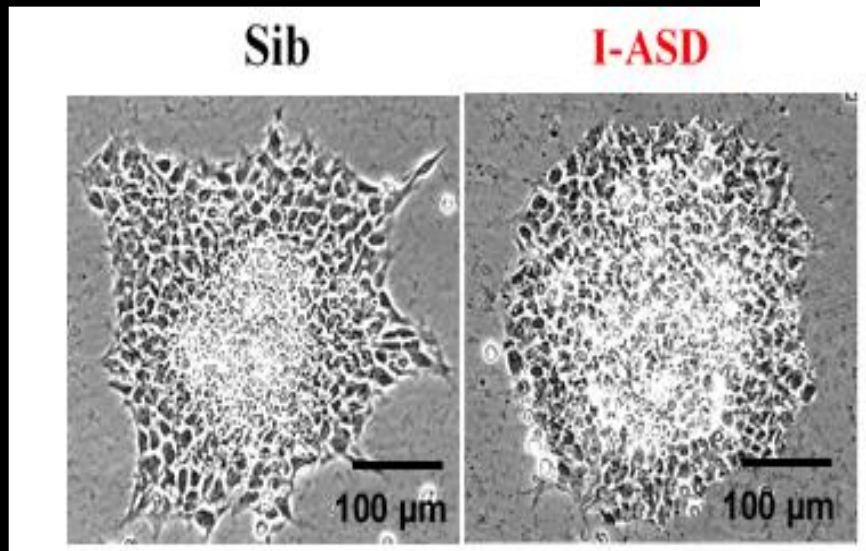
Enforces

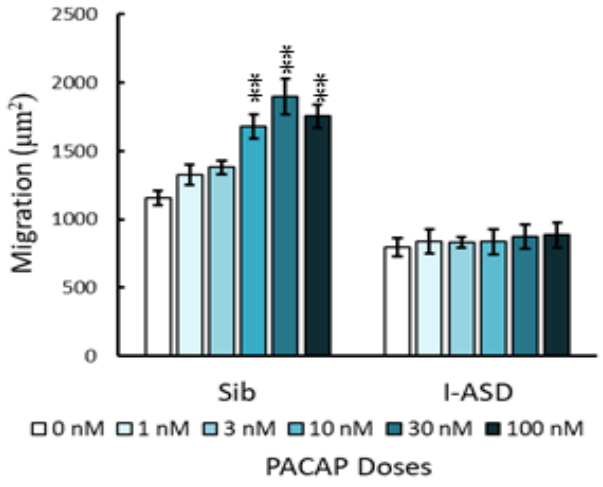
Gaussian Distribution

Collaborative Work (2 Labs Rutgers)

- Manual count
- One size fits all Model
- Loss of Gross data

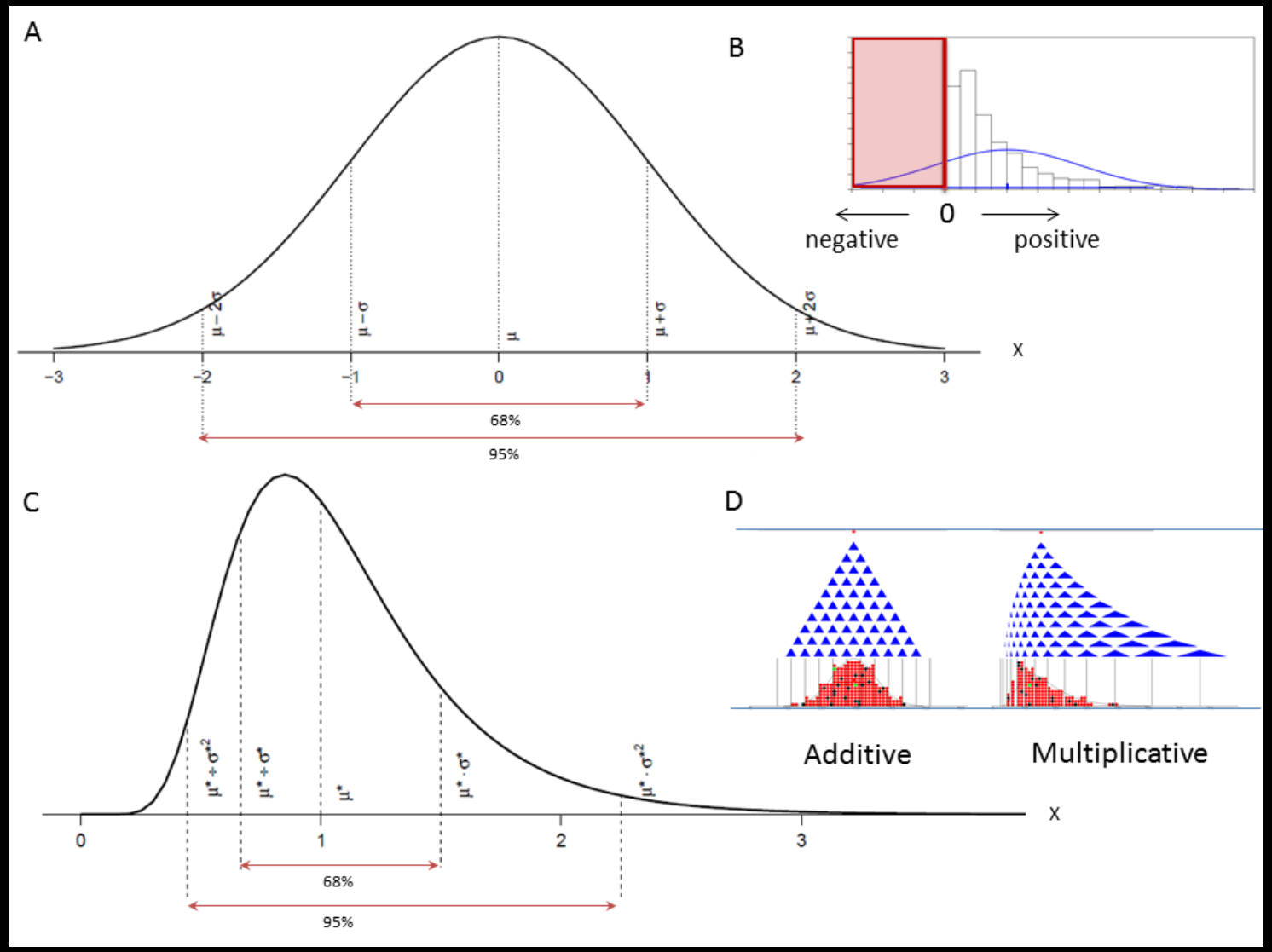




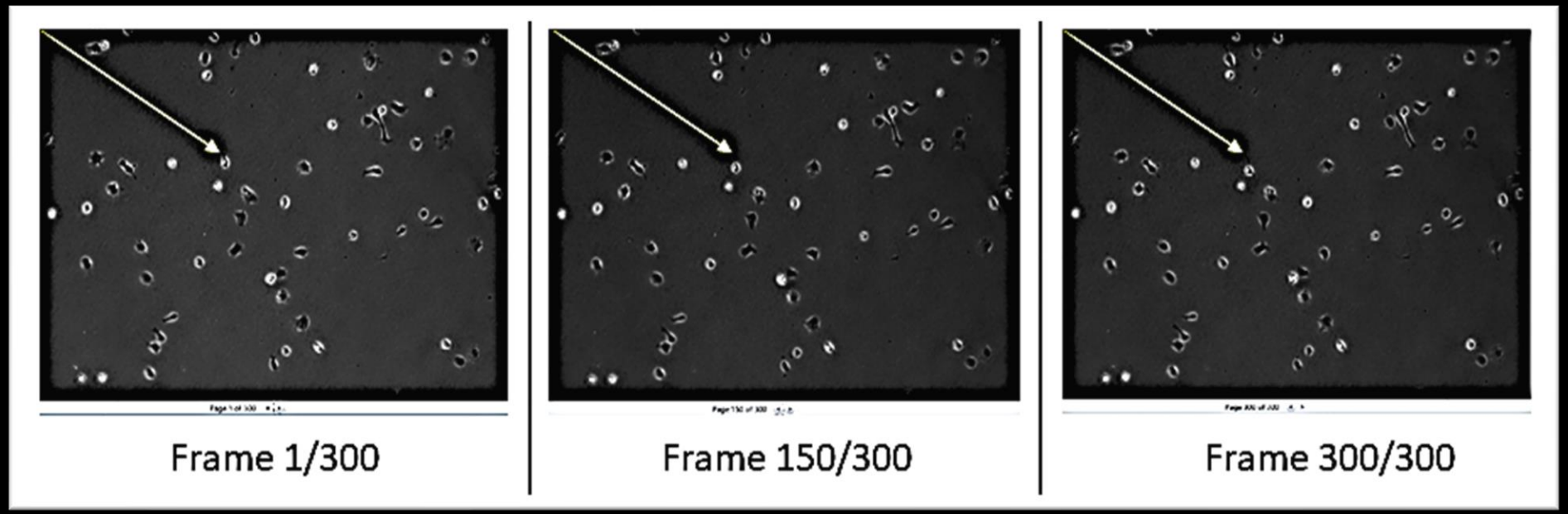


rres

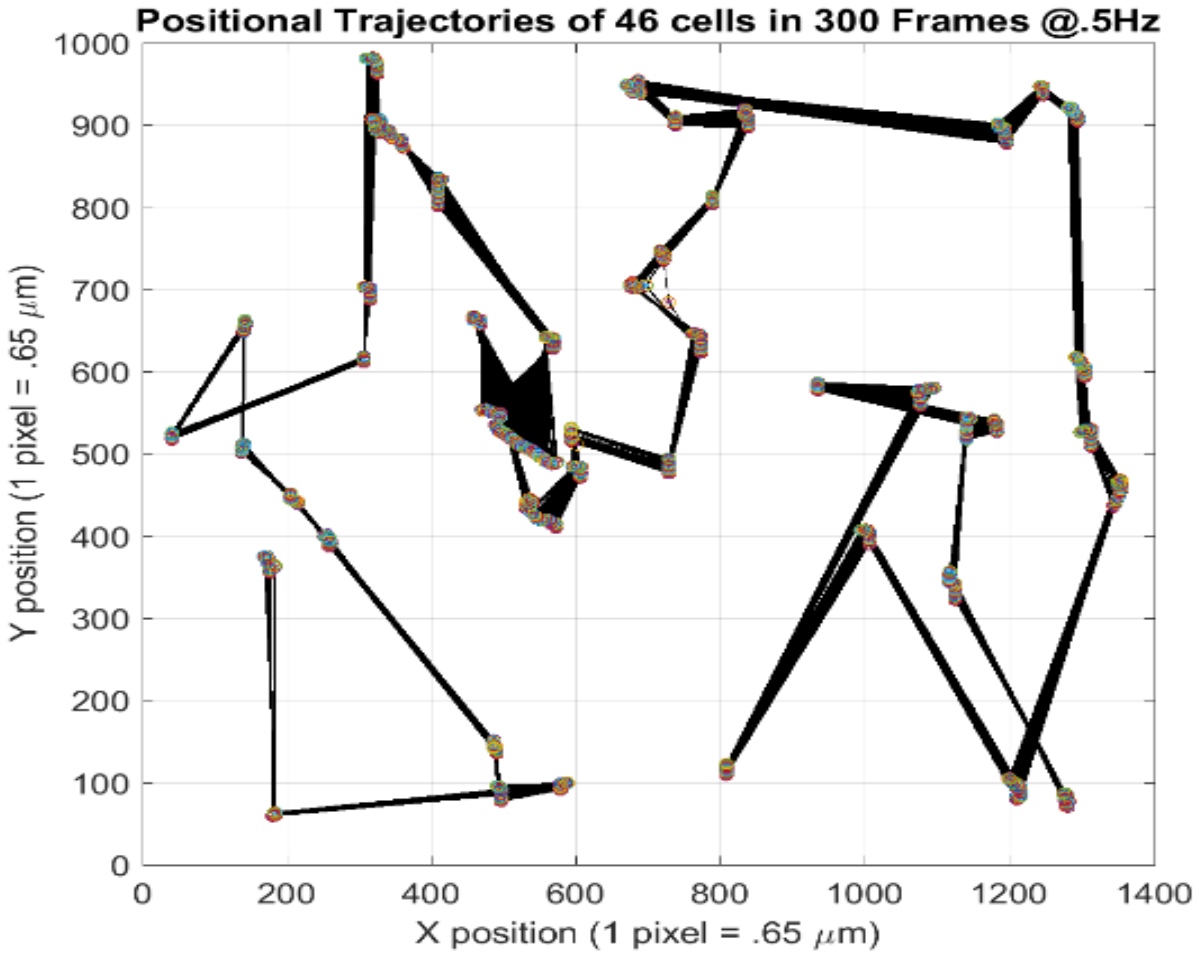
A priori assumptions do not fit biophysical data from biorhythms

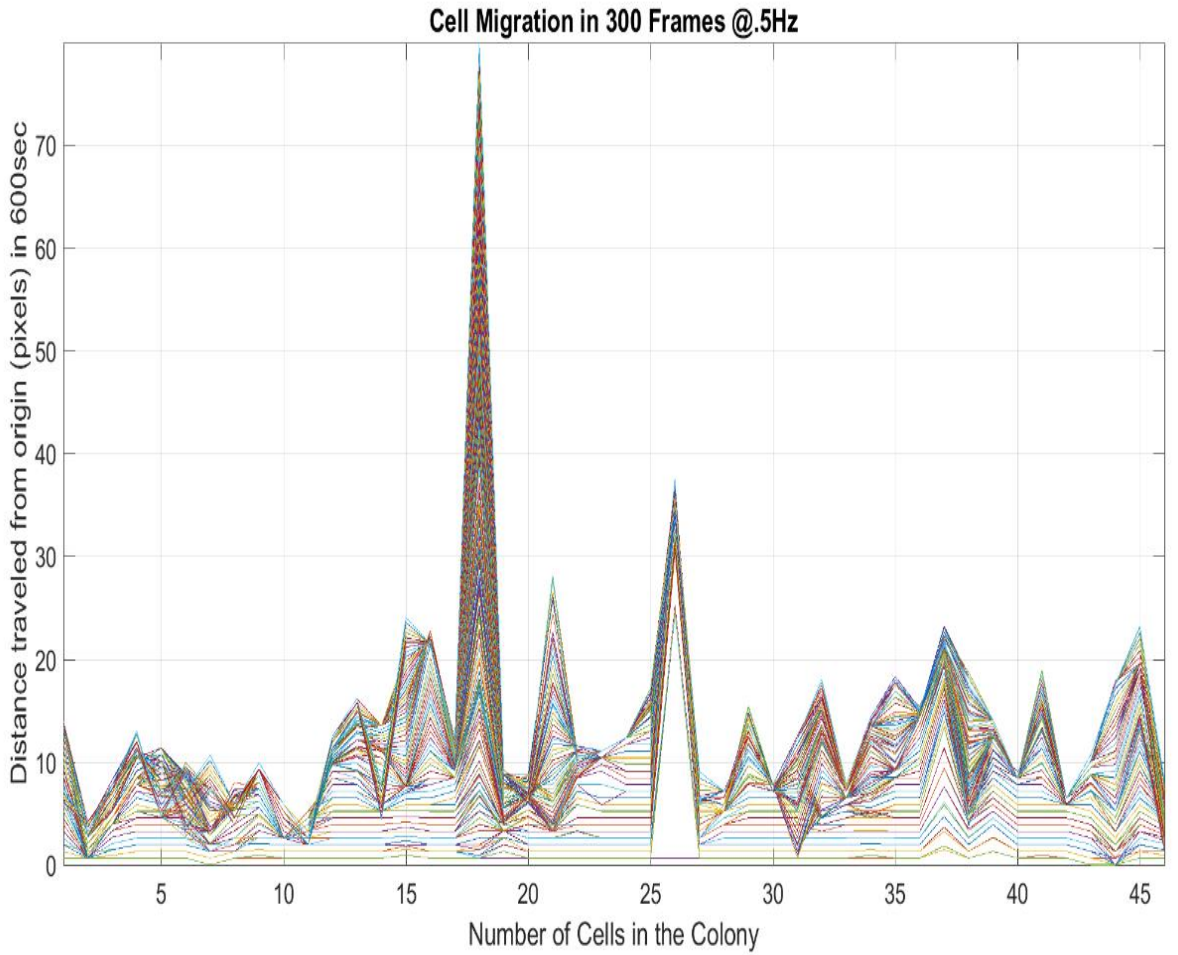


Cell Tracker Software (capture motion at .5Hz)

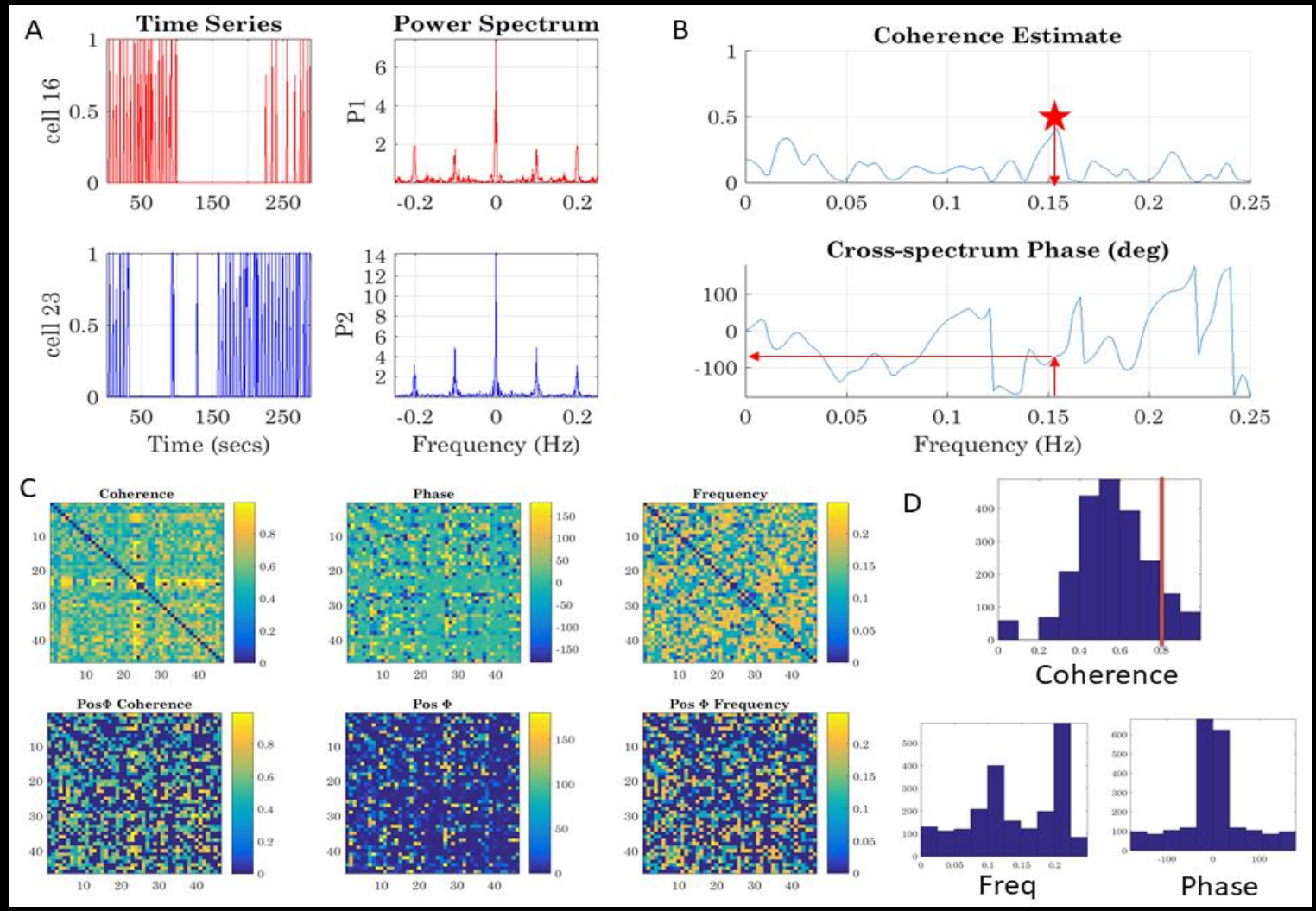


Provides Trajectories from Each Cell (1 pixel = .65µM)

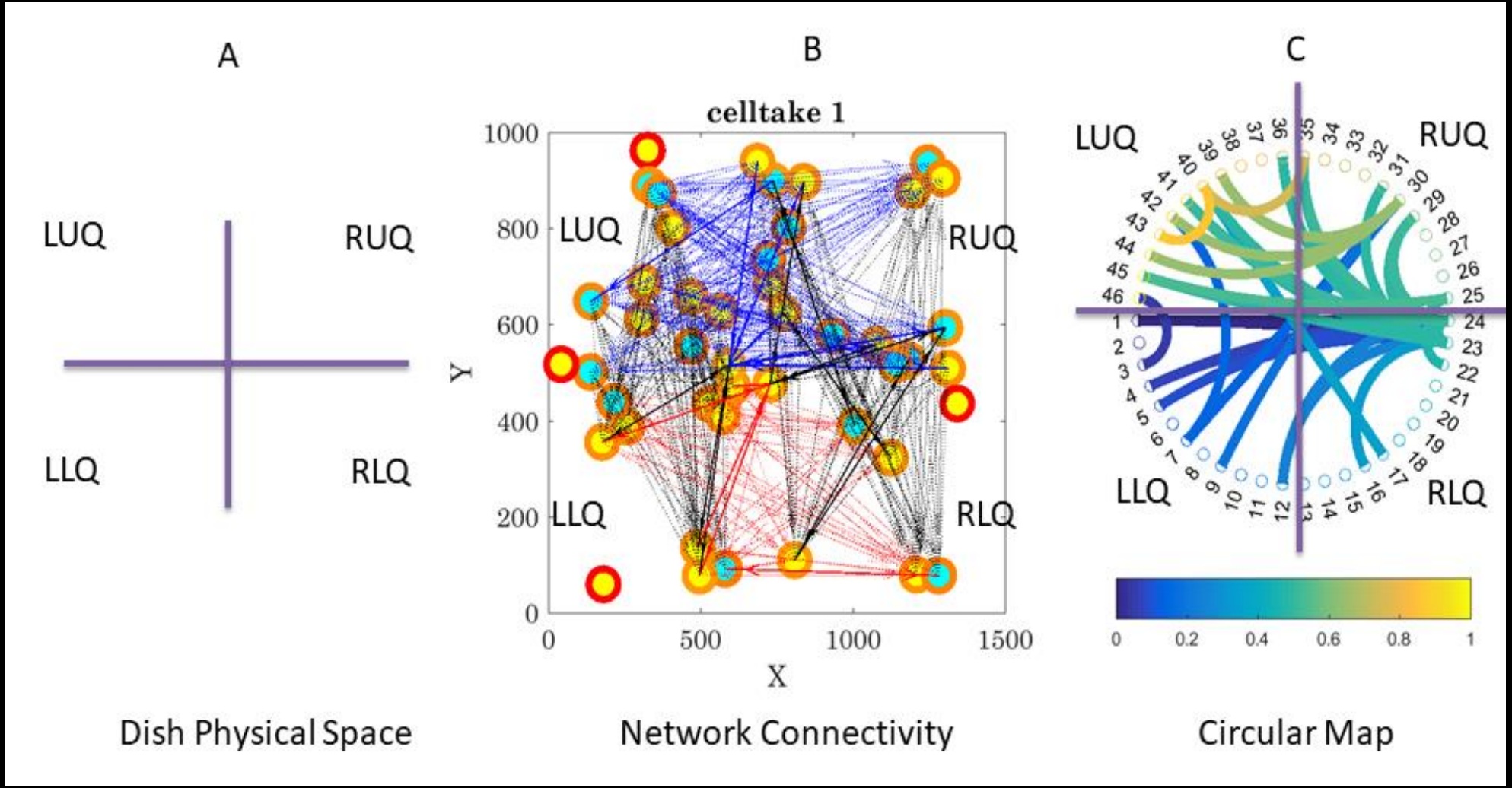




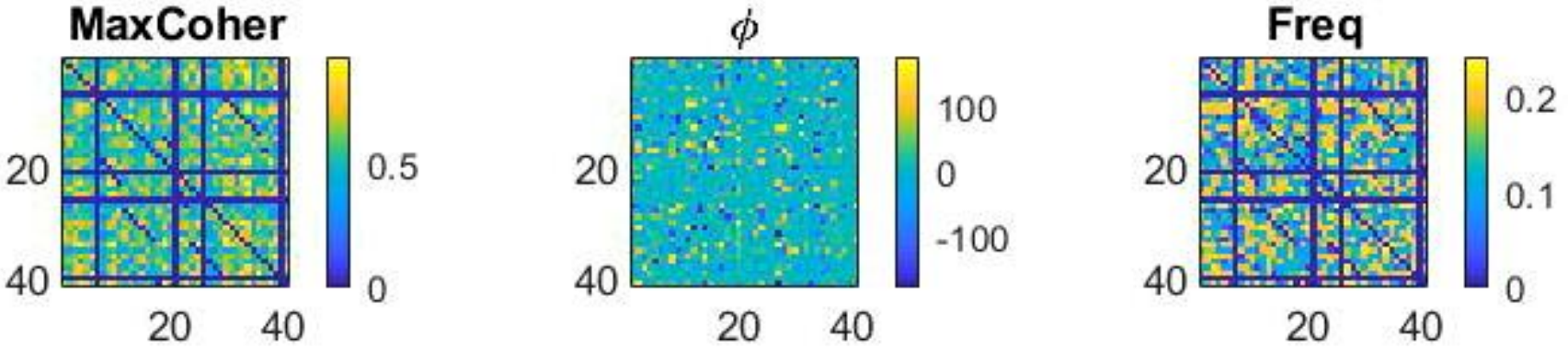
Parameterization of cell colony motion and self emerging cohesiveness



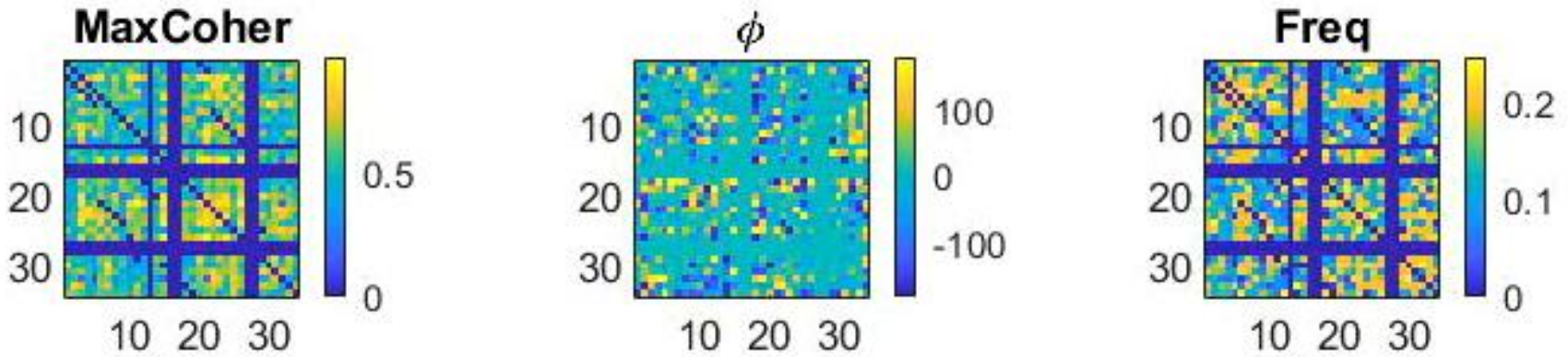
Mapping network abstraction to physical space



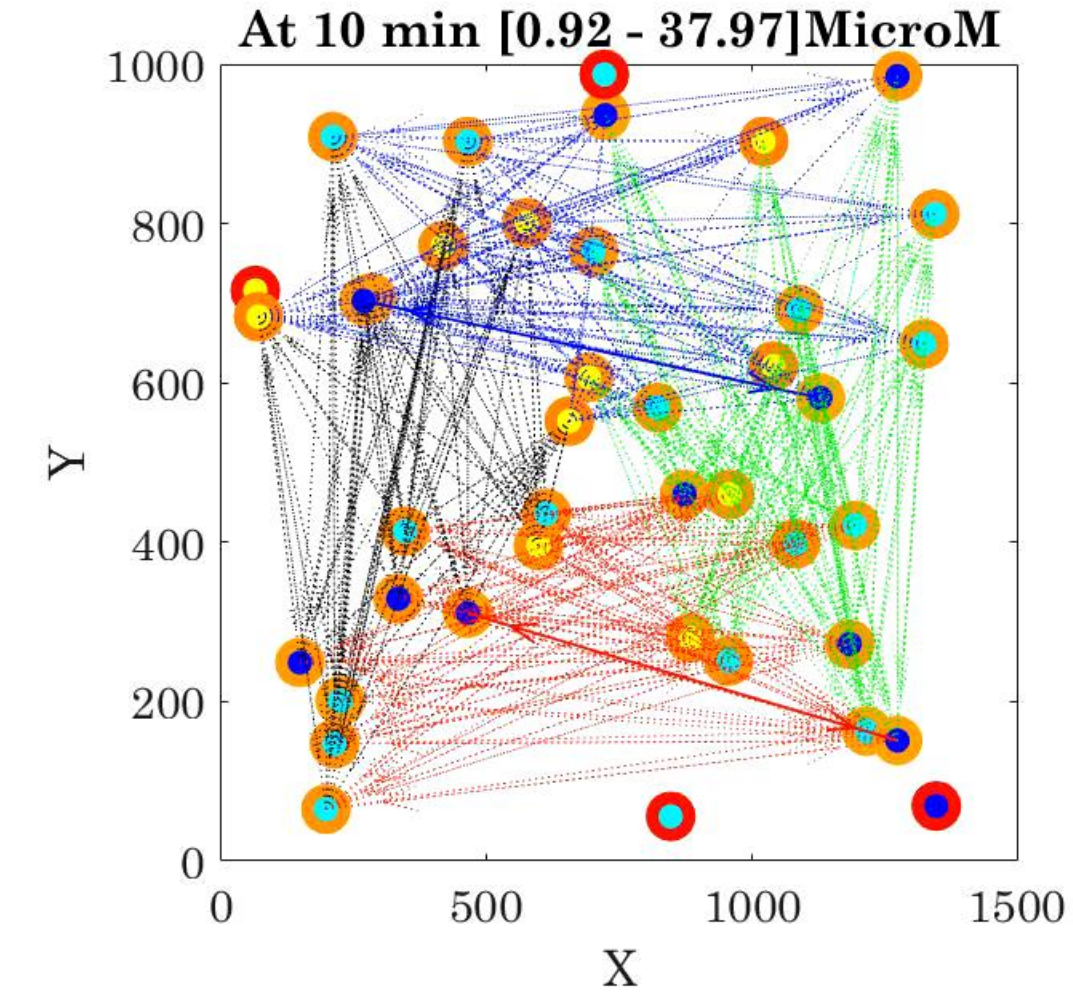
CONTROL

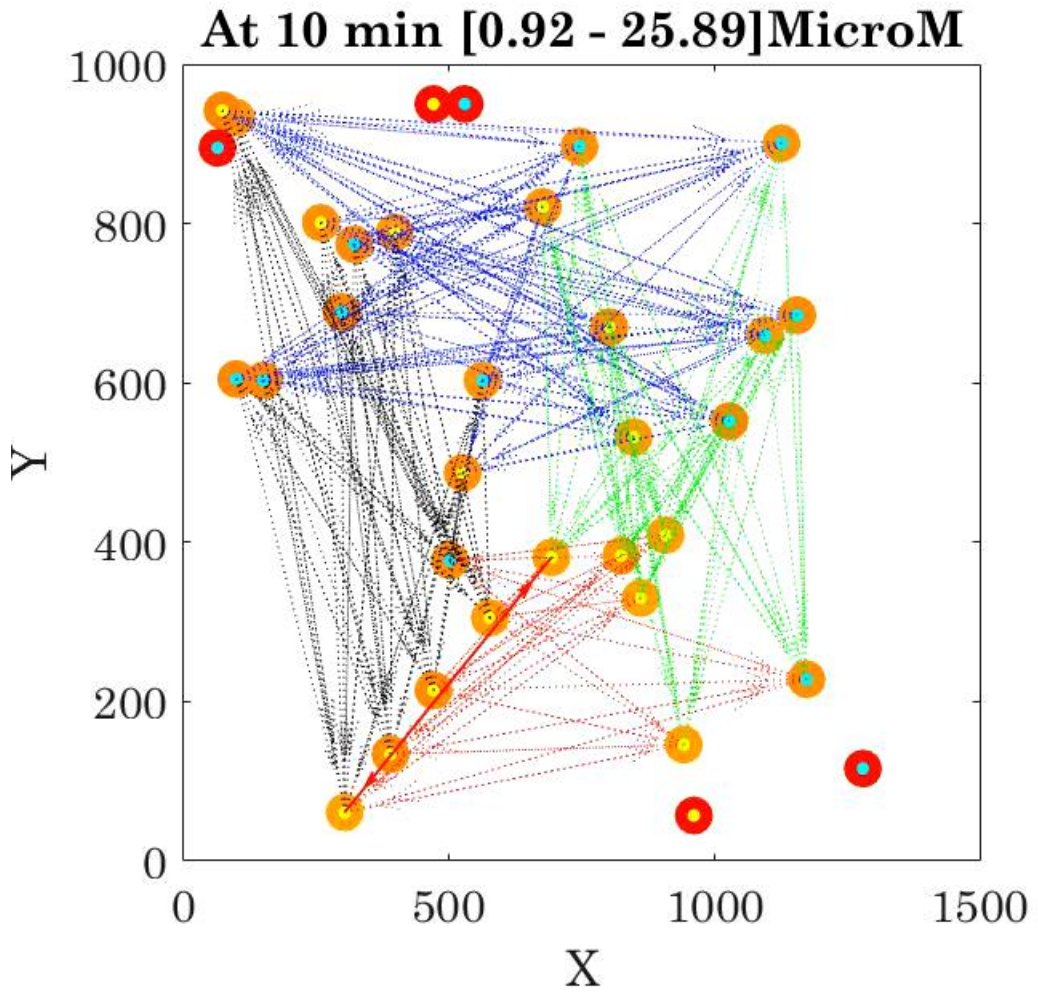


AUTISM

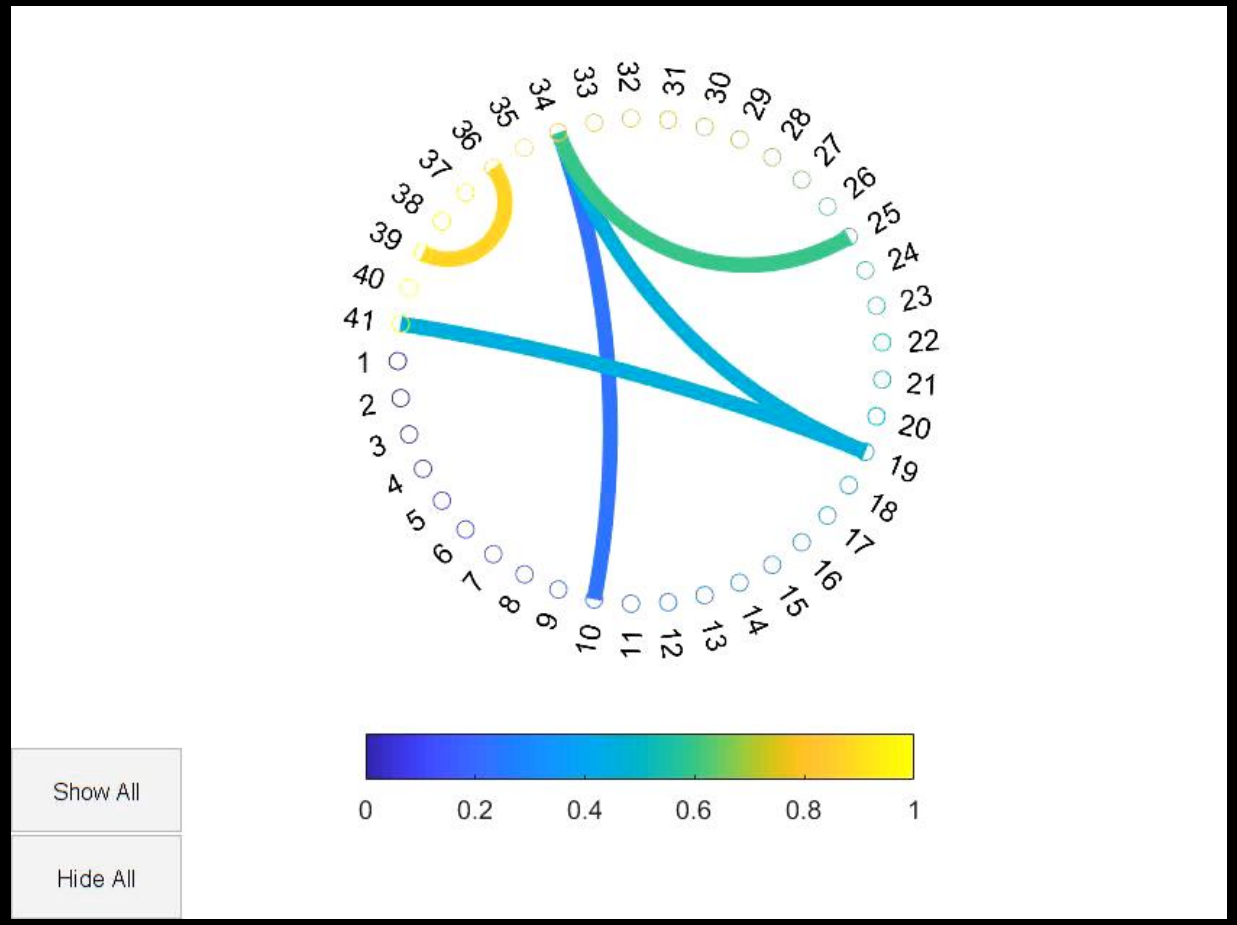


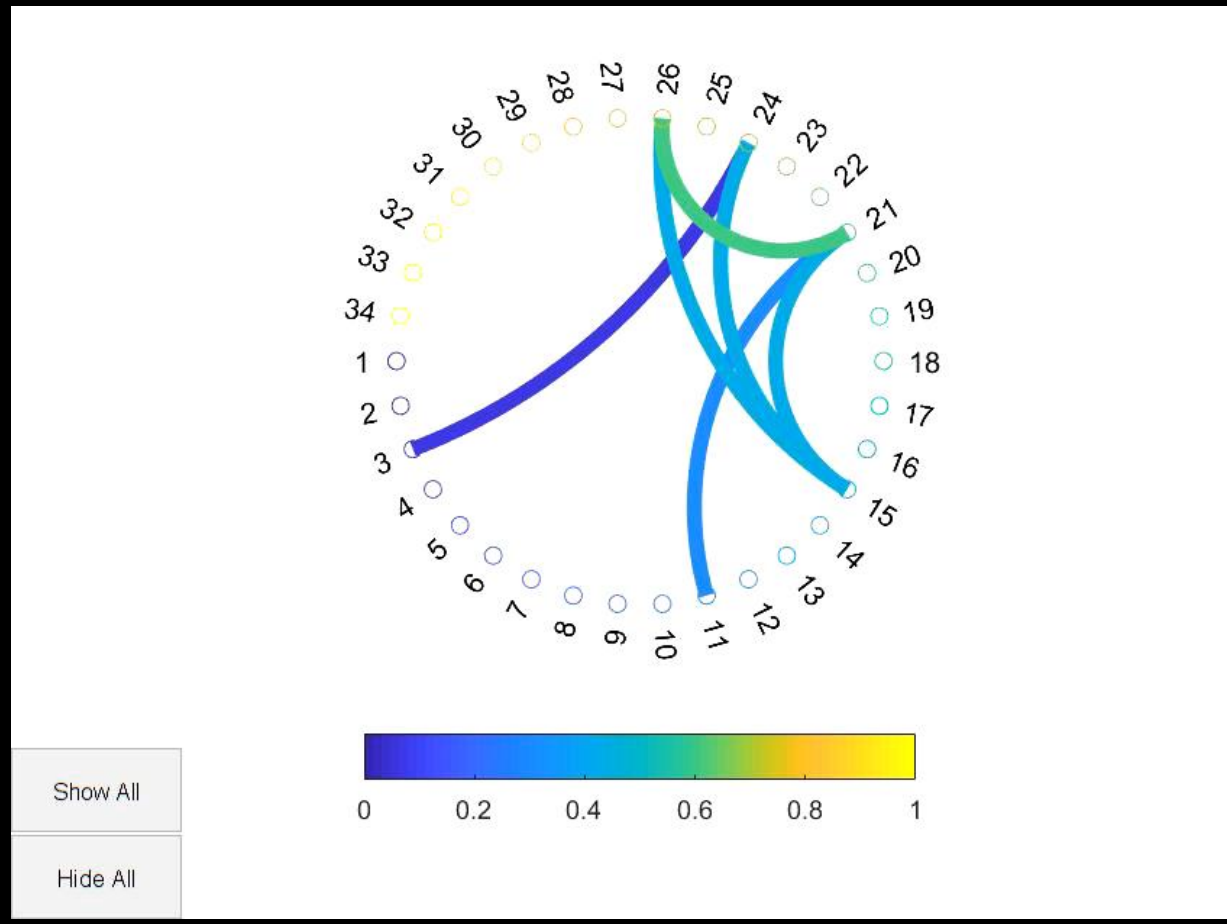
CONTROL vs ASD





CONTROL vs ASD





Conclusions

- Everything is motion
- Biorhythms entrain
- Entrainment is objectively quantifiable
- This quantification can be done from Neurons to Complex Social Behaviors and the Performing Arts

Class Objectives - Lecture 1

- Learn about natural/biological behaviors from a biorhythmic perspective
- Learn about levels of behavioral description and their applications
- Translate existing methods in brain science to behavioral science
- Learn about biosensors
  1. What types of wearable biosensors are out there at our reach
  2. What are some caveats
  3. How to scale their use from lab basic science to e.g. 10K+ users

In class

- We will play with the data to learn how to plot it
- We will learn about kinematics and variability
- We will learn about the micro-movement spikes MMS and the Gamma estimation process
- We will learn about network connectivity analyses
- Goal of the class → Learn how to plot data, how to process it, how to analyze it, how to visualize it and how to interpret it