**This repository contains all code necessary to regenerate the figures found in:**   
Ianni G.R., Vázquez Y., Rouse A.G., Schieber M.H., Prut Y., Freiwald W.A. Facial gestures are enacted via a cortical hierarchy of dynamic and stable codes.

**Figure 1**

**Facial gestures are distinguishable during a naturalistic social paradigm**

1B : Facial posture prior to movement onset

1C: TSNE plot of marker positions

1D-F: Face PCs by weights, by temporal resolution, by trajectory

Data: markerTrajectories.mat, markerTrajectoriesTSNE.mat

Plotting: plotBehavioralTrajectories.m

Analysis: generateBehavioralTrajectories.m

**Figure 2**

**Single-Cell Activity and Selectivity in Cortical Face-Motor Regions.**

2B: Sample population activity of all simultaneously recorded cells and facial markers

Data: Fig2B.mat

Plotting: plotNeuralActivityMatrix.m

Analysis: plotRasterAllCells2021.m

2C: Peri-event time histograms of four neurons aligned to onset of three gestures

Data: Fig2C.mat

Plotting: plotPSTHs.m

2D: Bee plot of gesture preference indices (GPI) distributions for each cortical area

Data: Fig2D\_GPIvalues.mat

Plotting: plotGPIByRegion.m

Analysis: gesturePreferenceIndex.m

2E: Fractions of cells in each region with significant activity modulations by facial gesture type, time, and their interaction

Data: Fig2E.mat

Plotting: plotBhvTimeANOVAbyRegion.m

Analysis: facePrefANOVA.m, chiSquaredGOF.m

**Figure 3**

**Population encoding of Facial Gestures**

3A: Single-event population activity vectors cluster by gesture-type in neural state space

Data: Fig3A.mat

Plotting: plotSingleTrialsNeuralStateSpace.m

Analysis: calculateSingleTrialPCAallCells2021.m

3B: Decoding categorical gesture type from neural population activity

Data: Fig3B.mat

Plotting: plotSVMClassifierAcrossDays.m

Analysis: analyzeSVMClassifierAcrossDays.m, SVMClassifierAcrossDays.m, SVMClassifierPermutationTestingAcrossDays.m

3C, 3D: Trial-averaged, time resolved gesture-specific neural trajectories

Data: Fig3C.mat

Plotting: plotTrialAvgPCAallCells.m

Analysis: calculateTrialAvgPCAallCellsWithDistances.m

**Figure 4**

**Kinematic decoding and unique neural correlations during gestures**

4A, 4B : Kinematic decoding of facial gesture components by region

Data Fig4AResults.mat, Fig4ANullResults.mat

Plotting script:plotPSIDResultsVNull.m

Analysis: prepData2023.m, makePseduoPopPSID23.m, analyzePSIDWrapper.m (runs runCorePSIDAnalysis.m underneath)

Dependencies: /PSID/

4C: Strength of pairwise cross-gesture neural correlations (R2, threat v. lipsmack, threat v. chew, and lipsmack v. chew, one dot per recording) for each region

Data: Fig4C.mat

Plotting: plotCorrStructureAcrossExpressions.m

Analysis: calcR2BetweenPairwiseCorrelations.m, neuralCorrelationStructureAcrossExpressions\_wRankOrder.m

4D: Population response dissimilarity matrices, all regions

Data: Fig4D/(region).mat

Plotting: plotCorrStructureAcrossExpressions.m

Analysis: neuralCorrelationStructureAcrossExpressions\_wRankOrder.m

4E: Spike-triggered movement averages

Data, plotted: STMA/(pair).fig

Analysis: STMA2021wrapper.m, nullSTMAwrapper.m, evaluateSTMAwrapper.m

Dependencies:/STMA/

**Figure 5**

**Stable and dynamic coding of facial gestures across cortex**

Left plots

Data: Fig5\_left.mat

Plotting Scripts: plotCrossTemporalDecodingAcrossDays.m,

Analysis: analyzeCrossTemporalSVMClassifierAcrossDays.m,

Dependencies: crossTemporalSVMClassifierAcrossDays.m

Right plots

Data: neuralTrajectory\_combined.mat

Plotting: neuralTrajectoryCharacteristicsAcrossDays.m

Analysis: calculateNeuralTrajectoryAcrossDays.m

**SUPPLEMENTAL FIGURES**

**Figure S1**

Handscored gesture onsets compared to automatic detection by continuous facial marker tracking

Data: markerTrajectories.mat

Analysis, Plotting: compareManualScoring.m

**Figure S2**

Mutual information distributions by region

Data: FigS2.mat

Plotting: plotMutualInformationStatic.m

**Figure S3A**

Between-region categorical decoding accuracy over time

Data: Fig3B.mat

Plotting: plotSVMClassifierAcrossDays.m

**Figure S3B**

Categorical decoding curves by region

Data: Fig3B.mat

Plotting: plotSVMClassifierAcrossDays.m

**Figure S4A, S4B**

Euclidean distances between gesture-specific neural trajectories, per day

Data: FigS4.mat

Plotting: summarizeEuclideanDistancesOverDays.m

**Figure S4C**

Euclidean distances between gesture-specific neural trajectories, across pseudopopulations

Data: /Figure5/matfiles/neuralTrajectory\_combined.mat

Plotting: /Figure5/neuralTrajectoryCharacteristicsAcrossDays.m

**Figure S5**

Kinematic Decoding Performance by Region, with statistical comparisons overlaid

Data: /Figure4/matfiles/Fig4AResults.mat, /Figure4/matfilesFig4ANullResults.mat

Plotting script: plotPSIDResultsVNull.m

**Figure S6A, S6B**

Rank order similarity of gesture-specific neural correlations by region

Data: /Supplemental/matfiles/combined\_rankOrderStats.csv

Plotting: summarizeRankOrderStats.m

**Figure S7**

Diagonal Index, Temporal Generalization Windows of Cross-temporal Generalization Matrices by Region

Data: /Figure5/matfiles/Fig5\_left.mat

Plotting: metricsCrossTemporalDecoding.m

**Figure S8**

Examples of per day, per region behavioral clustering of individual trials in neural state space, separated by region

Data: /Figure3/matfiles/Fig3A\_(region).mat

Plotting: plotSingleTrialsNeuralStateSpace.m

**Figure S9**

Examples of per day, per region gesture trajectories in 3D neural state space, separated by region

Data: Fig3C.mat

Plotting: plotTrialAvgPCAallCells.m

**Figure S10**

Data: /matfiles/FigS10.mat

Analysis Scripts: /Supplemental/calcMutualInformationTimeResolved.m

Plotting Scripts: /Supplemental/plotMutualInformationTimeResolved.m