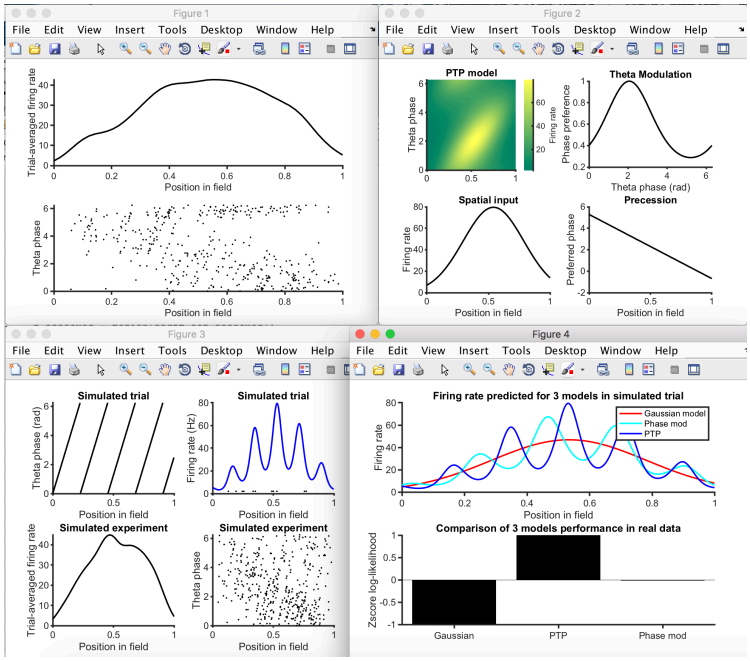
Code for position-theta-phase (PTP) model as it is presented in McClain et al. 2019

Author: Kathryn McClain
Email: km3911@nyu.edu
date: 7/23/19

Demo

To demo the model for an example place field, download the PTP model folder and add it to your matlab path with subfolders. Then run the 'demo_model.m' script to fit the model, simulate spikes, and perform a model fit comparison. The code should take ~2 minutes to run and should generate the figures to the right.



To make the same figures for a different place field, change the number in line 13 from '150' to another number between 1 and 179, which is the number of place fields in the dataset. (Note: some fields do not have enough spikes to fit. If errors occur try another field. However, there should not be errors for field 150.)

Data

An example data set is included in 'example_dataset_DT2_20160227.placefieldinfo.mat' which is organized by place field. Loading this file will load a 'stModel' struct, which has some metadata then a list of fields. Each field has some metadata (eg. cell it belongs to, type of behavioral trial it is defined in) and a list of trials. Each trial has a matrix of data where each row is a datapoint, sampled at 1250 Hz and the columns are organized as [timestamps, spike/no spike, position, theta phase, speed] (for more details on how these variables are computed from raw data see methods section of paper).

Code

The code is structured around a 'pfModel' object, which is defined in 'pfModel.m'. This is a general place field model object, which takes in a rate function and contains the functions that are used to compute parameters of a rate function from data. A PTP model can be created with 'ptpModel.m'. This is an instantiation of the pfModel object and a generalized PTP model that can estimate parameters and calculate firing rates for the PTP model equations from place field data. Two other model variants are included in 'gausModel.m' and 'phaseModModel.m', which are described in Figure S3.

As shown above, ‘model_demo.m’ demonstrates the PTP model for one example place field. ‘fit_basic_models.m’ can be used to fit the three models to each of the place fields in the example dataset by running ‘fit_basic_models(‘example_dataset_DT2_20160227.placefieldinfo.mat’), which will save this parameter estimates and log-likelihoods in the same file under each field. This will take several hours to run, but can be shortened by reducing the number of fitting iterations in the calls to ‘parameterDistribution’ and ‘compareModels’ functions.

Questions?

For general electrophysiology processing and analysis see https://github.com/buzsakilab/buzcode. For questions about the PTP model implementation please email Kathryn at the address above.