Model Documentation

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4.1 Motivation

4.1.1 Modular Software Architecture

While the CA3_CA1 model is still in a proof-of-concept stage it will serve as the foundation for a larger project to generate models based on *in vivo* experiments and prototype neuromodulation systems. To facilitate this project it is necessary to have a robust computational platform to integrate these steps. This is accomplished through a modular system architecture that will allow for the different components of the platform (mathematical model, optimization program, interface, etc) to be developed in parallel and extended as the overall application matures.

The other advantage for a modular architecture is the ability to develop a set of unit tests that can verify new changes do not have undetected effects by regressing against ground truths and previous versions. Finally, when these bugs are detected, the clear delineation between software components will decrease the amount of time necessary to fix.

4.1.2 Dynamic Specification of Model Structure

While the overall application maintains a modular architecture, the computational core of model needs to also be dynamic so that models of different structure and parameterization can be configured on the fly. The most immediate focus is the septohippocampal model which acts as the primary *in vivo* arm of the project, and can use different implants - electrodes or fiber optic ferrules, different optogenetic constructs, viral promoters, and different LED wavelengths.

In addition to the varied configurations of the septohippocampal model, there are several additional datasets from other studies becoming available. However, these data sets use different signal modalities in the case of data from patients receiving deep brain stimulation for treatment resistant depression, and can have structural properties that vary between patients in the DARPA Restoring Active Memory (RAM) trial.

4.1.3 Validation and Refinement

By using a robust software architecture that allows for flexible and agile development it will increase the rate of adaptation with the Emory neuroengineering community. This will allow the scientific theory underlying the model to be validated in a variety of contexts and experimental environments. Furthermore, the different operating systems used among the different labs will encourage cross-platform development and testing from the ground up rather than porting after the code base is more developed. Finally, building a system that can generalize to the needs of different users will serve to further test and refine the application.

4.2 Design

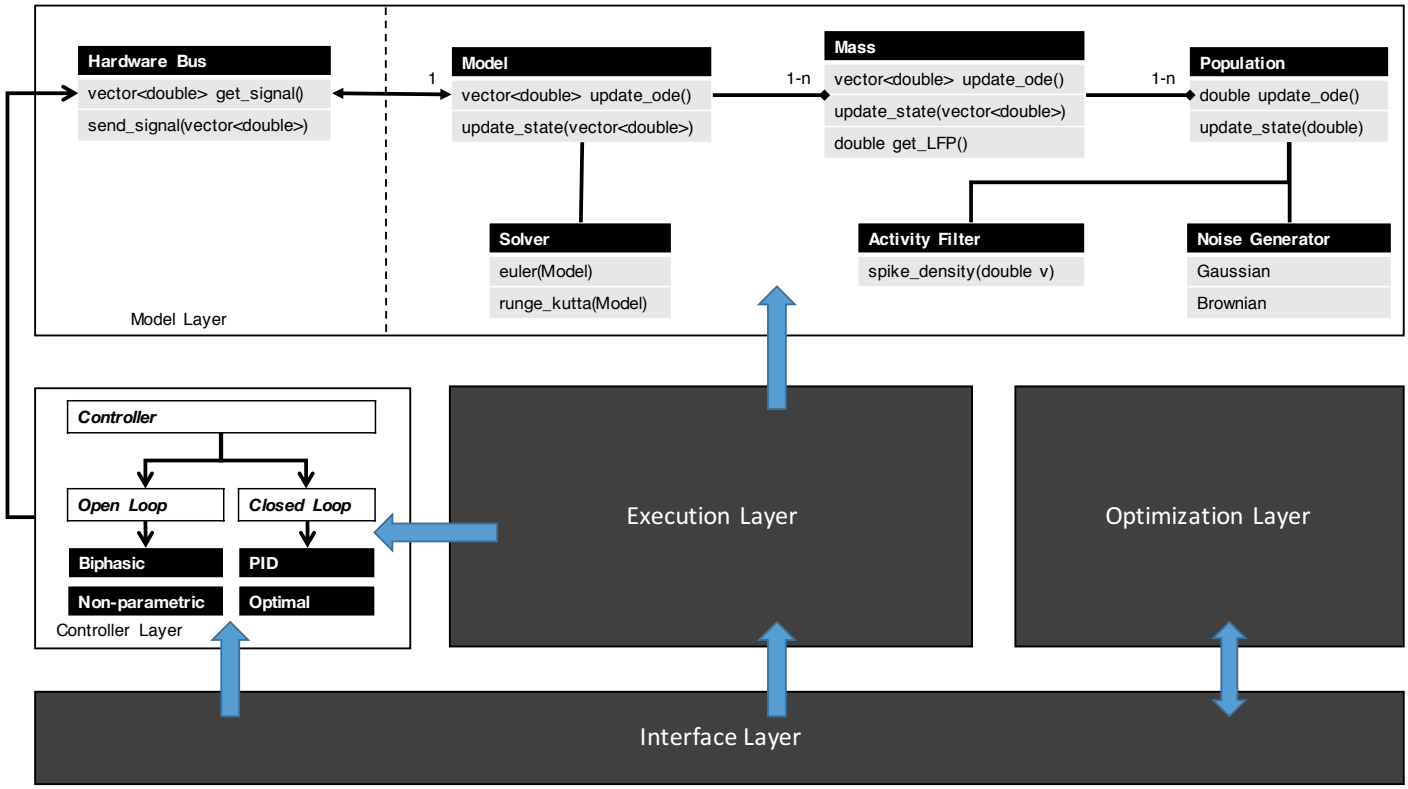

Figure 1: Software Architecture Diagram

5 Operation

6 API