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**Algorithm:**

This code simulates a branched tree structure in two dimensions. Initially, 2-4 randomly oriented branches are generated from the origin (0,0) and then the tips go through three state dynamics G-P-S with different rates Kgp (signifying transition rate from Growth to shrinkage phase), Kgs, Kpg, Kps, Ksg, Ksp as provided by the user. New branches spawned from an existing branch at a random place with a user-provided rate. For a more detailed description and algorithm please see Shree et al, Sci. Adv, 2022. A file containing the following parameters is necessary to run the code:

///////Parameters for simulating branched neuronal Morphology

N\_Sample=1;///Number of samples to simulate

Time\_Steps=10000;////Maximum number of time steps, each time step is 0.1

Tip\_Persis=250.0;////Persistence length of soma in um

BranchingAngleMean=90.0;////Mean branching angle wrt mother branch in degrees

BranchingAngleStd=5.0;////Std dev of branching angle wrt mother branch in degrees

BranchingRate=0.005;////branching rate per min per micron;

Vg=1.250;///Tip Growth Velocity micron/min

Vs=1.0;//absolute value of tip shrinkage velocity micron/min

Kgp=0.50;//Transition rate from growth to pause /min

Kgs=0.50;//Transition rate from growth to shrinkage /min

Kpg=0.50;//Transition rate from pause to growth /min

Kps=0.50;//Transition rate from pause to shrinkage /min

Ksg=0.50;//Transition rate from shrinkage to pause /min

Ksp=0.50;//Transition rate from shrinkage to growth /min

//////////////// Boundary ////////////////////////////////

Boundary\_type=repulsive;//options are "repulsive", "static", "free" and "pbc"

SizeX=200.0;//// Box Size in X direction in micron

SizeY=200.0;//// Box Size in Y direction in micron

//////////////////////////////// Data dumping parameters /////////////////////////

Print\_Conf=yes;///Print Configuration Images in pgm format (write yes/no)

Dump\_Conf=1000;///Dump image every

Dump\_Data=1;///Dump image every

pixelsize=0.1;////in micron

**Output:**

The code outputs neuron morphology data in .swc format along with skeletonized image in .pgm format. Additionally, the code produce a Timeseries data containing Branch number, branch lengths etc.

**Requirements to run the code:**

1. gcc
2. cmake (VERSION 3.24)
3. UNIX/Mac Operating System

**Building and installing the code:**

**To build the code run the following commands sequentially.**

cd “path to NeuronMorphologySimulator”

cmake -S src/ -B build/

cmake --build build/

cd build

make install (you might need to use sudo make install if the access is denied)

**Running the code**

To run the code just type the following in the command window:

NMorphSim Parameters.in

Example of the image file: