A Computational Investigation of Ionic Transport and Gating Due to Electrical Stimulation Treatments

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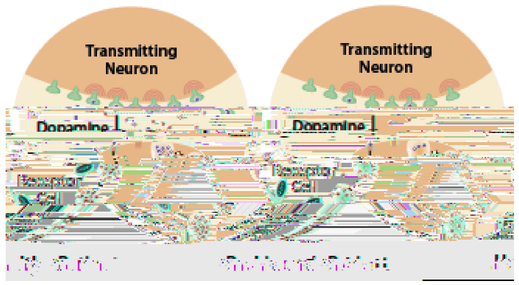
! athematics Department" #oger $illiams %niversit

! otivation

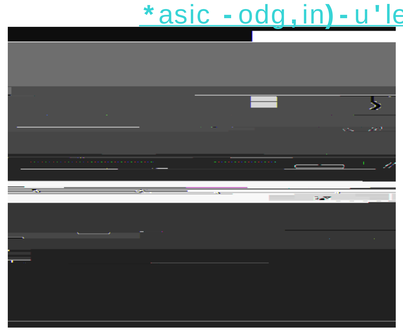
2ar,inson3s disease .2D/

Calcium .Ca01/

- S mptoms
- Treatment



*asic -odg,in)-u'le ! odel

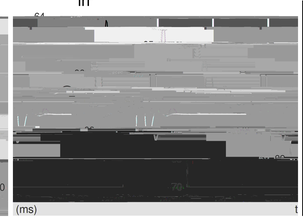


$$\frac{dV}{dt}$$

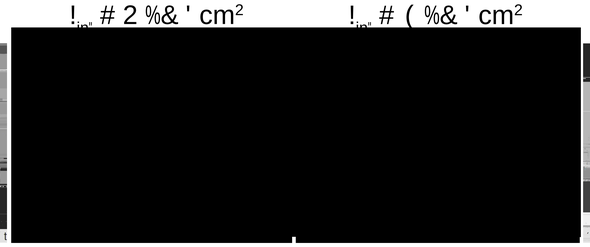
Simulations and #esults

!in" # $ %& ' cm²

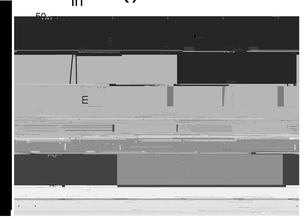
!in" # 1 %& ' cm²



!in" # 2 %& ' cm²

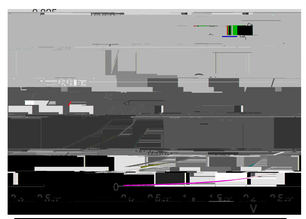


!in" # (%& ' cm²

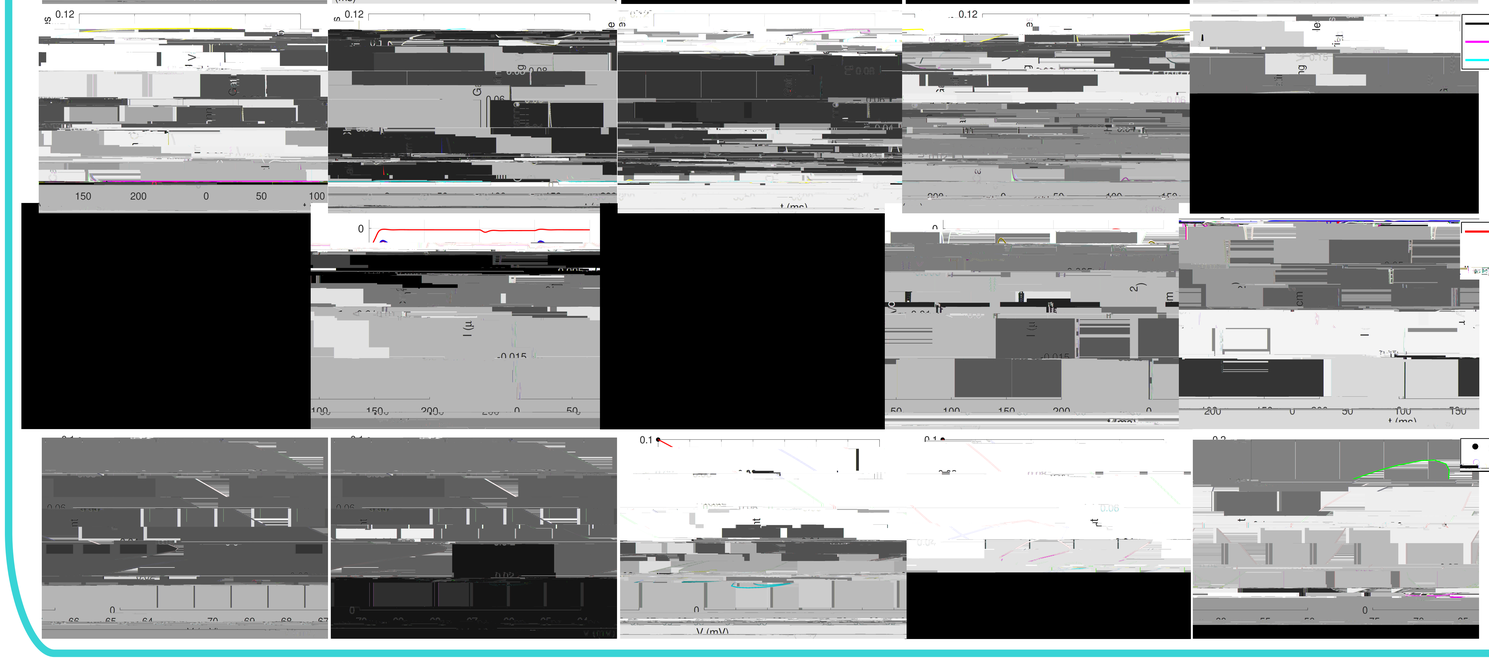


!in" # ()5 %& ' cm²

*a²⁺ ,ynamics -s) .oltage



$$I = G + G m^3 h (V - E)$$



Conclusions

- / e obser-e an exponential increase in calcium flow as the -oltage increases
- 0hase diagram3s steady-state is reached with a consistent2 yet increasing complex tra'ectory
- !nacti-ation gating -ariables contribute less rele-ance to ionic flow than acti-ation gating -ariables
- There is an ine-itable crosso-er on our extreme -alues graph2 that is ultimately accomplished during action potential
- The L-type channel has greater calcium inflow than the T-type channel for all in'ection le-els tested
- !t is obser-ed that *a²⁺ ionic flow is enhanced by electrical stimulation treatments such as ,345 this is supported by the exponential relationship between *a²⁺ and membrane -oltage
- !t is also obser-ed that though the T-type *a²⁺ channel has faster kinetics than the 6-type2 it transports less *a²⁺5 this further supports the notion that both T and 6-type channels are therapeutically -ital in 0, pathogenesis and treatment

&e't Steps

Anal (e multi)dimensional phase diagrams

E'amine model prediction accurac with comparisons to D*S clinical and medical literature

Integrate Cell ! odel with larger)scale +)dimensional electrical stimulation simulations

#eferences

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Ac,nowledgments

Dr. -eimer) ! cGinn .# $ %/ for feedbac, and support