Home Work - Assignment 1

Markov Modeling of Ion Channels: Rate Coefficient Functions and Parameterization



Implementation

 Implement 4 two-state Markov models, each with a) a nonlinear rate coefficient function α and b) a constant rate coefficient function β:

$$\begin{aligned} \frac{dO}{dt} &= \alpha \ C - \beta \ O \\ \frac{dC}{dt} &= \beta \ O - \alpha \ C \\ O: & Probability of channel is in open state \\ C: & Probability of channel is in closed state \\ \alpha, \beta: & Rate coefficient. function of V_m \end{aligned}$$

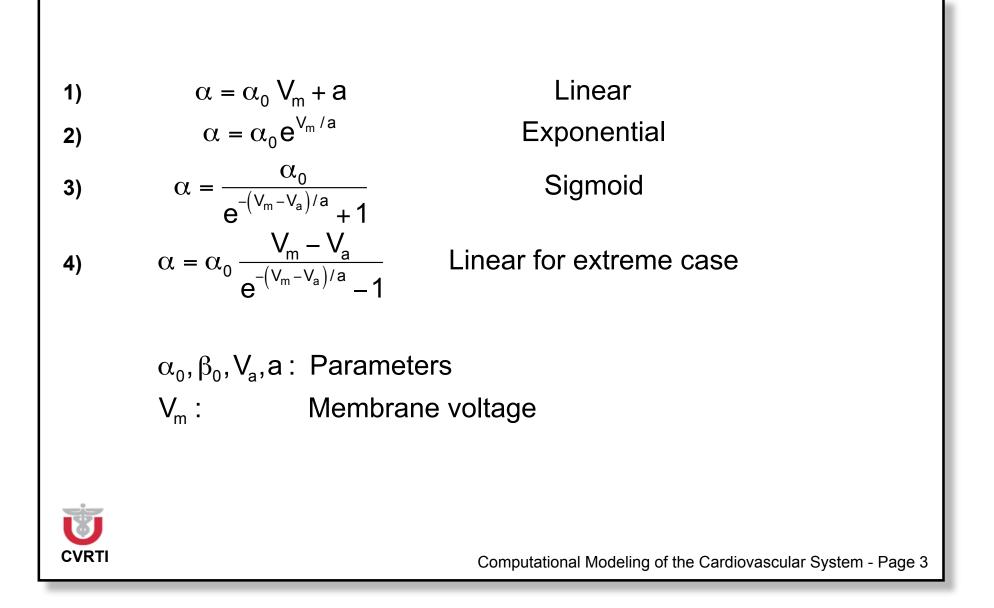
(Hint: Is it necessary to implement the second equation?)

• Implement a method for numerical solution of the model



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Rate Coefficient Functions for Model 1-4



Parameterization and Characterization

- Select parameters for the models which fulfill the following conditions:

 a) steady states (C≈1, O≈0) for V_m=-100
 b) transition from (t=1s, C≈1, O≈0) to (t=2s, C≈0, O≈1)
 for the voltage step protocol
 V_m=-100 for 0s<t<1s
 V_m=0 for 1s<t<2s
 (Acceptable tolerance 1%)
- Describe your approach for parameterization and potential alternatives
- Perform and visualize simulations with the voltage step protocol V_m = -100 for 0s<t<1s $V_m \in \{-100, -50, 0, 50, 100\}$ for 1s<t<2s
- Characterize the response of the channel models to the voltage step



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