

2010 Departmental Seminar

Friday 28 May 2010
2.00 pm
Erskine Bldg. – room 446

Modelling nephron dynamics and tubuloglomerular feedback

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Abstract:

The TGF mechanism is an autoregulatory mechanism unique to the kidney that maintains approximately constant blood flow to the organ despite wide fluctuations in pressure. It is present in each of approximately one million small tubules called nephrons in each human kidney. Oscillations in pressure, flow, and sodium chloride concentration have been attributed to the action of the TGF mechanism through a number of experimental studies.

A mathematical model of a single nephron from Holstein-Rathlou et al. uses a partial differential equation (PDE) model for the tubule and a second-order differential equation (DE) for the TGF feedback. The use of this second-order DE is uninformative as it is inherently oscillatory. The second order DE was replaced by a first order DE, which represents relaxation to a target value. This model is oscillatory due to the delays in the system.

The computationally expensive PDE model was simplified to an ordinary differential equation model by assuming a spatial profile. This model exhibits much of the same qualitative behaviour as the PDE model including sustained oscillations for similar ranges of parameter space. This model is less computationally expensive than the PDE model and allows analysis that was unfeasible with the PDE model.