



Online
seminar

Monday **October 19, 2020** at 16:30

Hosted on: [Meet](#)

Gillian QUEISSER

Associate Professor at Temple University

Numerical Methods and Computational Models for Applications in Neuroscience

Prof. Grillo introduces the seminar.

Abstract

In order to study the interplay between 3D neuronal architecture and electrical and biochemical signaling it is necessary to develop detailed mathematical models, based on physical first principles, that integrate accurate reconstructions of neuronal and organelle morphology. The computational workflow therefore begins with methods to reconstruct neuronal and organelle morphology in three space dimensions. From such reconstructions surface and volume grids are generated to define the computational domain on which systems of partial differential equations (PDE) (the model) are solved numerically. Discretization of the PDE leads to, typically, very large linear systems that need to be solved efficiently. Highly parallel and efficient numerical solvers need to be developed for the purpose of solving ultrastructural problems.

To address all aspects of the computational workflow from raw morphology data, e.g. in form of 3D confocal microscopy data, to detailed 3D simulation results, we present reconstruction methods and numerical solvers that were specifically developed for dealing with neuronal signaling in an efficient way.

The presented methods are used in the context of neuronal calcium signaling at the level of single organelles, to ultrastructural domains (e.g. synaptic spines) to whole cell and network dynamics. Results demonstrate various aspects of structure-function interplay in neurons that demonstrate the ability of neurons to structurally adapt to fine-tuned biochemical function.

Biography

Prof. Gillian Queisser received his Diploma in Mathematics in 2006 and his PhD in Applied Mathematics in 2008 from the University of Heidelberg, Germany. From 2008 to 2010, he was independent group leader of a research team at the Excellence Cluster CellNetworks at the University of Heidelberg. He was Junior Professor of Computational Neuroscience at the University of Frankfurt (Germany) from 2010 to 2015 and he currently is Associate Professor of Mathematics in the Department of Mathematics at Temple University, USA.