Mathematical Methods and Models in Biosciences
June 18-23, 2023, Pomorie, Bulgaria
https://biomath.math.bas.bg/biomath/index.php/bmcs

Mathematical challenges in triggered drug delivery: getting the right dose to the right place at the right time

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The brain tissue is protected by the blood-brain barrier: a wall of tightly-packed cells that keep unwanted molecules from crossing from the blood vessels into the tissue. This presents challenges to delivering therapeutic drugs to locations in the brain to treat certain diseases. One approach to meeting this challenge is to encapsulate the drugs in sono-sensitive nano-carriers. These vesicles can then be made to release their cargo locally using focused ultrasound beams at intensities that are not damaging to the surrounding tissue. Mathematical problems come up when trying to answer questions such as: How can we describe the kinetics of drug transport and distribution through the tissue? What is the best positioning for an array of ultrasound transducers in order to produce the required signal at the right spot in the brain? What ultrasound parameters and dosages produce the the desired drug profile at the target region?

In this talk I will discuss the specific mathematical challenges, as well as some approaches to their solution.

This is joint work with Peter Hinow (University of Wisconsin in Milwaukee).