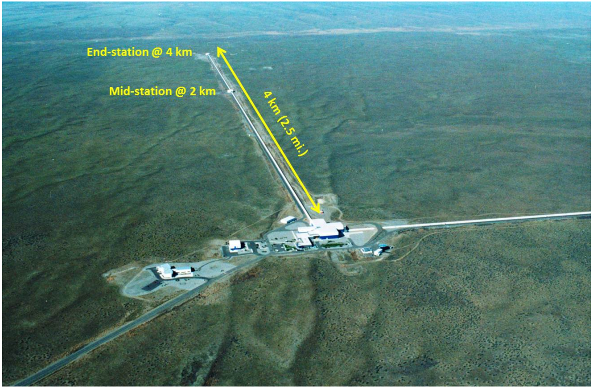
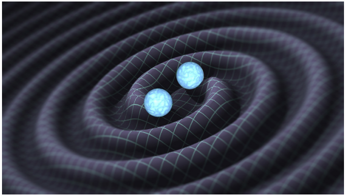
Finite Element Methods: Applied theory and theoretical applications

Andrew Gillette

Recruitment Workshop Presentation

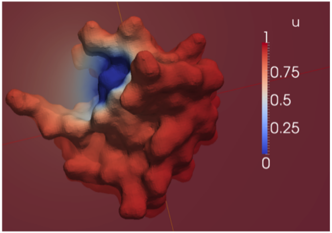
A problem at a large scale

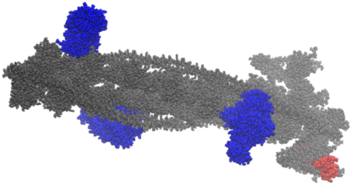


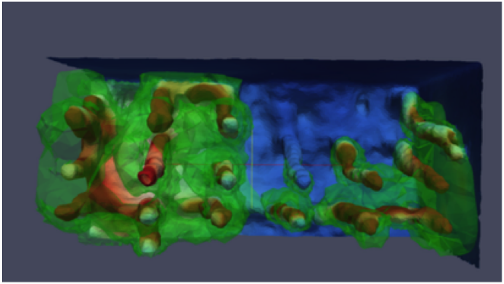


(images from ligo.caltech.edu)

A problem at a small scale



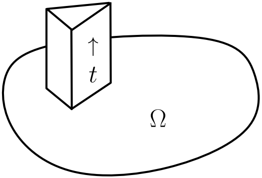


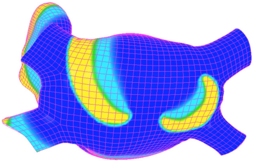


Mathematics for applications

Mathematics helps bridge the theory and application gap at any scale:

- What partial differential equation correctly describes the physical reality?
- Does the PDE have a unique solution, bounded in some norm?
- How can you reliably compute an approximate solution to the PDE?
- Is the solution method optimally efficient?





$$\left[\quad \mathbb{A} \quad\right]\left[\mathbf{x}\right] = \left[\mathbf{b}\right]$$

Real analysis

PDEs

Geometry / Topology

Combinatorics

Linear algebra

Numerical analysis

Focus of my research in these areas: the **Finite Element Method**

Some statistics about finite element methods

- Google Scholar search for “finite element method”:

  1.3 million results;   6,780 results in 2017 alone

- MathSciNet search for “finite element method” in title:

  9345 results;   485 results in 2013 alone

Finite element methods offer a wealth of questions in both mathematical theory and applications!

http://math.arizona.edu/~agillette/