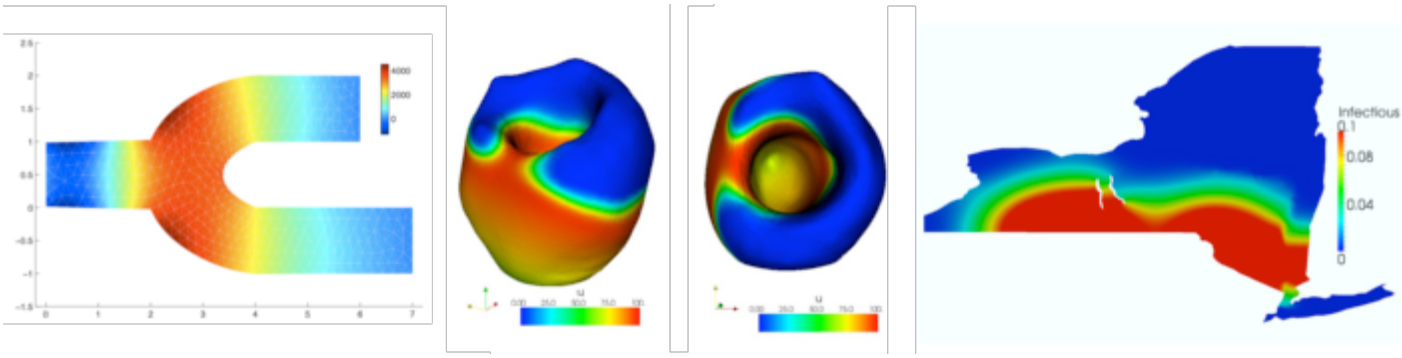
basque center for applied mathematics

WORKING GROUP Mathematical Modeling in Biosciences



Wednesday, May 31, 2017 (12:30-13:30h)

BCAM, Mazarredo 14, 48009 Bilbao, Basque Country, Spain

www.bcamath.org

Jamie PREZIOSO, Case Western Reserve University

AN INVERSE PROBLEM OF CEREBRAL HEMODYNAMICS IN THE BAYESIAN FRAMEWORK

The increased cerebral metabolic rate following neuronal activity triggers a rapid increase in cerebral blood flow (CBF), a phenomenon that is at the base of several functional imaging modalities. While the connection between the brain activity and increased CBF has been demonstrated, the details of the neurovascular coupling remain unclear. Mathematical models of cerebral hemodynamics assume a ballooning of the vessels to accommodate the additional blood, however, many details of these models remain to be explained, and several of the key parameters are unknown. To model mathematically the vascular system's response to neuronal activation by increasing vascular compliance, an auxiliary function, a vasodilatory stimulus function, is introduced, however, there is no quantitative way to observe or measure this. We set up a series of inverse problems to estimate a nonparametric vasodilatory stimulus from observations of CBF and propose an approach based on Bayesian hierarchical models, utilizing qualitative a priori knowledge. Finally, we introduce a statistical modeling error framework to account for the uncertainties in the poorly known model parameters.

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EXCELENCIA SEVERO OCHOA