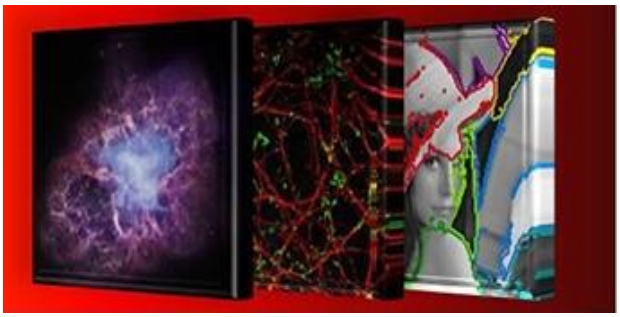

Computational inverse problems

Giornata seminariale

23 giugno 2015

Dottorato di Matematica delle Università di Ferrara, Modena e Reggio Emilia, Parma

Ferrara, Polo Scientifico Tecnologico- Blocco B – III piano, Aula seminari –

Ore 10:00 – 10:40 The interferometric imager of the Large Binocular Telescope: a challenge for image reconstruction methods
Mario Bertero, Università di Genova

Ore 11:00 - 11:40 Sequential Monte Carlo and particle methods in inverse problems
Daniela Calvetti - Case Western Reserve University

Ore 12:00 - 12:40 A hierarchical Krylov-Bayes iterative solver for MEG inverse problems
Erkki Somersalo – Case Western Reserve University

Abstracts

The interferometric imager of the Large Binocular Telescope: a challenge for image reconstruction methods – Mario Bertero

The Large Binocular Telescope is an innovative instrument consisting of two 8.4m mirrors on the same mount. This structure allows Fizeau interferometry which can provide true images of an astronomical target. However the resolution of a single image is anisotropic so that one must acquire different images with different orientations of the astronomical target in order to produce, by means of image reconstruction method, a unique image with the best resolution in all directions.
The first interferometric images of LBT were obtained during the night of December 24, 2013. The target was Io, one of the four Astri Medicei discovered by Galilei in 1610 and characterized by a strong volcanic activity.
In the lecture, after a short description of LBT, the difficulties in reconstructing a satisfactory image of Io are discussed and a new method for obtaining such a result is proposed.

Sequential Monte Carlo and particle methods in inverse problems – Daniela Calvetti

In sequential Monte Carlo methods, the posterior distribution of an unknown of interest is explored in a sequential manner, by updating the Monte Carlo sample as new data arrive. In a similar fashion, particle filtering encompasses different sampling techniques to track the time course of a probability density that evolves in time based on partial observations of it. Methods that combine particle filters and sequential Monte Carlo have been developed for some time, mostly in connection with estimating unknown parameters in stochastic differential equations. In this talk, we present some new ideas suitable for treating large scale, non-stochastic, severely stiff systems of differential equations combining sequential Monte Carlo methods with classical numerical analysis concepts.

A hierarchical Krylov-Bayes iterative solver for MEG inverse problems - Erkki Somersalo

The inverse problem of MEG aims at estimating electromagnetic cerebral activity from measured magnetic fields outside the head. After formulating the problem within the Bayesian framework, a hierarchical conditionally Gaussian prior model in introduced, and point estimates of the solution are computed using an iterative alternating sequential (IAS) updating algorithm, coupled with a Krylov subspace iterative linear solver equipped with statistically inspired preconditioning and a suitable termination rule. A physiologically inspired preconditioned that takes into account the preferred directions of the brain activity is introduces, and the sensitivity scaling widely used in the literature is formulated in terms of an empirical Bayes technique. Extensive studies based on simulated single time slice and time series data clearly show the sensitivity of the computed solutions to the physiological preconditioner and to the parameters of the hyperprior, in particular in the case of focal activity.