Consiglio Nazionale delle Ricerche
ISTITUTO DI RICERCA SULLE ACQUE

Avviso di Seminario

"A new data assimilation technique based on ensemble Kalman filter and Brownian bridges: an application to Richards' equation"

joint work with Andrea Andrisani, Luciano Lopez e Michele Vurro

Relatore : Dott. Marco Berardi - I.R.S.A.

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SALA MULTIMEDIALE
V.le F.sco De Blasio 5 – Z.I. Bari

Abstract

Marco Berardi

A new data assimilation technique based on ensemble Kalman filter and Brownian bridges: an application to Richards' equation

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Data assimilation is a growing research field which aims to incorporate observations into a dynamical model in order to improve the modelling of an evolutionary process, usually described by a differential system. Typically, data assimilation serves two different goals: to better estimate the states of the system or to retrieve model parameters of the system itself.
Here, an original data assimilation procedure stemming from the *ensemble Kalman filter* is used just to correct the system states between one observation and the following one. This means that we include the uncertainty on the parameters in the general expression of *model error*.
Such a technique will be effective if few observations of a dynamical system are available and a large model error occurs. The idea is to acquire a fine grid of synthetic observations in two steps:
1) first we interpolate the real observations with suitable polynomial curves;
2) then we estimate the relative measurement errors by means of *Brownian bridges*.
This technique has been tested on the Richards' equation, which governs the water flow in unsaturated soils, where a large model error has been introduced by solving the Richards' equation by means of an explicit numerical scheme. The application of this technique to some synthetic experiments has shown improvements with respect to the classical ensemble Kalman filter, in particular for problems with a large model error.
This result has been recently published here
http://www.sciencedirect.com/science/article/pii/S0010465516302132 .

Biografia e Attività scientifica

PhD in Mathematics with a thesis titled *IVP for ODEs with discontinuous right-hand side: event driven methods and applications to singularly perturbed problems*, defended in April 16th 2012.
During his PhD he worked on one-step and multistep methods for differential equations with discontinuous right-hand side, and on their continuous extension, focusing on one-sided methods.
In the context of a FCRP project, he worked on modeling piecewise linear differential equations with applications to Genetic Regulatory Networks, and on glucose-insulin models. From 2013 he has a post-doc position at CNR – IRSA and he is working on modeling of unsaturated zone, and mainly on infiltration processes. In the topic of Richards' equation, he works on schemes for its numerical solution, by means of method of lines. At the same time, he is studying data assimilation techniques using Kalman filters, in the context of infiltration processes. He has developed a new data assimilation method based on ensemble Kalman filter and Brownian bridges. Currently he is working on a model for infiltration in multilayered soils.

Venue

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