Post-doc position
– Laboratoire I3S, Sophia Antipolis –

Project title. Design criteria for spatial prediction by kriging: accounting for the added uncertainty due to the estimation of stochastic characteristics

Framework/support. International ANR/FWF project "**DESI**gns for Spatial **R**andom Fi**E**lds" (DESIRE) – in collaboration with the Statistics Department of the Johannes Kepler University (JKU), Linz, Austria

Supervisors. Luc Pronzato & Joao Rendas, Laboratoire I3S (http://www.i3s.unice.fr/I3S/)

Start date. Before September 2012

Duration. *One year*, with the possibility of prolongation for a *second year* funded through the same ANR project

Project details.

The project addresses the problem of defining *efficient designs* (location of observations points, sensors, etc.) *for observation of spatial fields* within a statistical framework. While the objectives cover numerous industrial and scientific applications, the project will remain at a fundamental level, with the aim of identifying appropriate modeling frameworks for distinct specific instances of the spatial observation problem, as well as expedite algorithms to compute associated efficient designs.

When setting up an experiment to observe a spatial phenomenon, the common practice is to use space-filling designs that *spread out the inputs more or less uniformly across the available space*. This has become a standard approach in particular in computer experiments, where physical (costly) experiments are replaced by (sometimes time-consuming but cheaper) numerical simulations. In industrial contexts, this is known as *virtual prototyping.* The same sampling approach is also currently used for the deployment of the majority of existing sensor networks. At the same time, the uncertainty due to the estimation of the stochastic characteristics of the random field is usually ignored. The project aims at (i) taking this uncertainty into account in the definition of design objectives related to the precision of prediction/interpolation, (ii) defining simplified design criteria that can be efficiently optimized through specific algorithms, (iii) constructing optimal designs sequentially, taking dynamical constraints into account in order to consider applications to the deployment of mobile sensors. This last point corresponds to the sequential construction of optimal placements of mobile sensors, which forms a (stochastic) control problem, and can be reformulated as an *attempt to fill the gap between optimal control and statistical inference*.

The one-year post-doc position concerns points (i) and (ii) above. The possible prolongation for one second year would concern point (iii).

More precisely, in terms of modeling, the field will be considered as being the superposition of a deterministic component and a realization of a (spatially correlated) stochastic process. Compared to more classical (parametric) approaches, it has the important added values of flexibility and reduced sensitivity with respect to the choice of the parametric families on which the field is described. The prediction at unsampled locations is then obtained

(explicitly) by kriging (Krige, 1951), a method that is now rather standard in spatial statistics, including applications to computer (i.e., simulated) experiments since the pioneering work of Sacks et al. (1989). Although this prediction technique is now rather usual, we intend to improve current results in several directions: (i) a more precise accounting of the added uncertainty on predictions due to *estimation* of the stochastic characteristics of the field from the same data set as that used to construct predictions, (ii) the extension of this corrected "prediction of uncertainty on predictions" to *localized objectives*, such as the construction of a level set (input space) for a response of interest (observation space) or the optimization of a response (to be contrasted with *global objectives*, where one aims at constructing precise predictions of the response over the whole input space).

Dissemination of the methods developed will be done through publications together with the production of open source code (R) or Matlab® programs that will be made available on the internet.

Suitable candidates. The successful candidate should have excellent knowledge in mathematics and statistics and good computer programming skills, preferably in Matlab® or R. A PhD in statistics or related fields is expected, ideally with some experience in experimental design.

Funding details. The position is funded by the joint ANR/FWF project "DESIRE" with a salary of about € 2110/month (netto) and is available to candidates of all nationalities. The student will be expected to visit the JKU (for up to one month over the one year period). The visits will be financially supported by the project.

Contact and application. Informal enquiries can be made by email to Luc Pronzato (pronzato@i3s.unice.fr) and Joao Rendas (rendas@i3s.unice.fr), to whom detailed CV and letter of motivation should be sent for application.

Application deadline. Open call until May 31, 2012