PostDoc in Mathematics:
Probability and Applications - Mean Field Models

Université Côte d'Azur,
Laboratoire de Mathématiques J.A. Dieudonné, Nice, France

● <u>LOCATION</u>

<u>Université Côte d'Azur</u> is located on the French Riviera. It is one of the ten French universities distinguished by a label of excellence (IDEX). It is also linked to other international research institutes: <u>INRIA Sophia-Antipolis</u>, which is a computer science institute, and the <u>3IA Côte d'Azur</u>, which is an artificial intelligence institute.

The <u>Dieudonné Mathematics Laboratory</u> is located on the Valrose campus of the Université Côté d'Azur, in the center of Nice. The research activity covers a broad spectrum of topics in mathematics, including a strong team in probability and statistics.

The successful candidate will work at Dieudonné Mathematics Laboratory.

● <u>SCIENTIFIC DESCRIPTION</u>

The successful candidate will work in the framework of the ERC AdG project ELISA (Exploration for Large Interacting Systems of Agents), directed by Professor <u>François Delarue</u>. This ERC project deals with mathematical theories and numerical tools for mean field models, which are used to describe the statistical state of a population, including mean field models of rational agents, such as mean field control problems and mean field games (see for the two volume book *Probabilistic Theory of Mean Field Games with Applications* by Carmona and Delarue and the research book *The Master Equation and the Convergence Problem in Mean Field Games* by Cardaliaguet, Delarue, Lasry and Lions). This also includes mean field models in which the state of the population itself is random.

Among the directions of research of the project, one key objective is to show that randomization (of the state of the population) can enable a form of exploration with theoretical and numerical advantages and benefits in statistical learning (see for instance the works arXiv:2401.13844, arXiv:2210.01239, arXiv:2107.00839). From a more analytical point of view, randomization is also expected to be connected with second order PDEs on the space of probability measures.

The post-doc researcher will work on one of the project's axes, depending on her/his own skills. Subjects may address:

(i) Construction of noises on the space of probability measures and smoothing properties of the related semi-group, especially in higher dimension (works cited above are only dedicated to the 1d framework), and connection with recent works on probability-measure valued processes (Dean-Kawasaki equation, Dirichlet-Fergusson diffusion);
(ii) Study of second-order linear and possibly non-linear PDEs on the space of probability measures;
(iii) Application to restoration of uniqueness to mean field models, with low regularity, including mean field games and mean field control and related selection by vanishing viscosity;
(iv) Convergence from finite-population to infinite-population models, with or without common noise;
(v) Study of mean field games with a major player and applications of mean field control techniques to neural networks or to weighted graphs, with or without common noise;
(vi) Computational and learning methods, using the smoothing and exploration properties of the noise.

● <u>POSITION</u>

This is a full-time position, for 2 years. Candidates should have a PhD in mathematics or applied mathematics, with a strong background in probability, stochastic calculus and/or nonlinear PDEs for stochastic control. Candidates must have demonstrated their ability to work independently and to publish in well-established international journals of mathematics or applied mathematics. Programming skills in scientific languages like C/C++, Python, TensorFlow or R will be appreciated but are not mandatory.

Université Côte d'Azur offers certain facilities. In particular, new researchers can benefit from a temporary accommodation of 1 to 3 months at the [Faculty Club of Nice](#).

The position will be open from September 2024.

Salary will be communicated on demand.

● <u>APPLICATION PROCEDURE</u>

Candidates may contact François Delarue (francois.delarue@univ-cotedazur.fr) for any questions.

Applications should be sent to francois.delarue@univ-cotedazur.fr: a letter of motivation, a curriculum vitae, transcripts of graduate degrees, PhD viva reports (if available), PhD diploma and at least two reference letters.

Pre-selected candidates will be interviewed online.

Applications are open till May 31st 2024.