Research Project

Mathematics and Applications in Sciences, Social Sciences and Engineering

The Department of Mathematics of the University of Bologna invites applications for PostDoc positions in “Mathematics and applications in Sciences, Social Sciences and Engineering”.

Candidates are expected to propose and perform research on innovative aspects in mathematics, along one of the following themes:

Analysis and Probability:

1. Functional analysis and abstract equations: functional analytic methods for PDEs problems; degenerate or singular evolution equations in Banach spaces; function spaces related to operator theory; inverse problems;
2. Applied PDEs and probability: PDE or stochastic modeling of financial markets; geometric analysis modeling of the visual cortex in Lie groups; FK percolation andapplications; mathematical models in medicine and biology;
3. Evolution equations: evolutions equations with real characteristics, asymptotic behavior of hyperbolic systems;
4. Qualitative theory of PDEs and calculus of variations: sub-Riemannian PDEs; a priori estimates, solvability and hypoellipticity of linear PDEs; analytic regularity of solutions of PDEs; spectral theory of differential systems with polynomial coefficients; geometric fully nonlinear PDEs; potential analysis of second order PDEs; geometric measure theory in Carnot groups; differential forms and differential geometry in Carnot groups; free boundary value problems; Hamilton-Jacobi equations;
5. Harmonic analysis.

Numerical Analysis:

1. Numerical Linear Algebra: matrix equations, matrix functions, large-scale eigenvalue problems, spectral perturbation analysis, preconditioning techniques, ill conditioned linear systems, optimization problems;
2. Inverse Problems and Image Processing: regularization and optimization methods for ill-posed integral equation problems, image segmentation, deblurring, denoising and reconstruction from projection; analysis of noise models, medical applications;
3. Geometric Modelling and Computer Graphics: Curves and surface modelling, shape basic functions, refinable functions, subdivision schemes, interpolation methods, parallel graphics processing, realistic rendering;
4. Matrix and tensor analysis and computations for PDEs, image processing and statistics.

Algebra/Geometry:

1. Secant varieties of projective varieties and tensor rank;
2. Combinatorics of permutations: algebraic and geometric aspects;
3. Numerical invariants of ideals in local rings and applications in singularity theory;
4. Superalgebras and representation theory: geometric and combinatorial aspects;
5. Geometric and topological invariants for shape analysis, comparison and retrieval;
6. Low-dimensional topology and knot theory.

Mathematical Physics:

1. Dynamical systems and ergodic theory;
2. Transport in deterministic and stochastic processes;
3. Mathematical aspects of quantum mechanics;
4. Statistical mechanics and applications;
5. Continuum mechanics and thermodynamics;
6. Non-linear wave propagation and non-equilibrium thermodynamics;
7. PDEs as mathematical models for applications in social and life sciences.

Mathematics for Economics and Finance:

1. Mathematical economics (nonlinear dynamical systems in economics, agent-based models in economics and finance);
2. Mathematical finance (hedging models, credit risk models, fuzzy models in finance, high frequency finance and market microstructure models);
3. Graph theory and network models in financial, economic, and transportation systems.

OTHER TOPICS MAY ALSO BE CONSIDERED.