PREFACE:
GEOMETRIC PROPERTIES FOR
PARABOLIC AND ELLIPTIC PDE'S

Qualitative aspects of parabolic and elliptic partial differential equations have attracted much attention from the early beginnings. In recent years, once basic issues about PDE's, such as existence, uniqueness, stability and regularity of solutions of initial/boundary value problems, have been quite understood, research on topological and/or geometric properties of their solutions have become more intense.

The study of geometric properties of solutions of parabolic and elliptic PDE's offers a broad range of options. A list of topics currently and actively investigated in this field includes, to name a few, positivity; critical points of solutions, their structure and possible occurrence and evolution; spike-shaped solutions; symmetry and non-symmetry of ground states and in overdetermined boundary value problems; stability of symmetric configurations; convexity, quasi-convexity or starshape of level sets of solutions; impact of curvature of the domain on the relevant solutions and their possible behavior for large or short times.

Investigations on these problems intertwine with many other areas of research and rely on a large chest of mathematical tools and techniques, both analytic and geometric, such as a priori estimates of solutions; isoperimetric inequalities; Pohozaev-type identities; maximum principles; Harnack inequalities; asymptotics for solutions; moving-planes methods; Liouville-type theorems, viscosity-solutions techniques, and so on.

Such a wide range of (often disparate) topics, results and techniques calls for a settlement: research monographs in this field have started to appear in recent years but any effort in this direction should be welcome.

This motivates the present collection of articles which presents results on symmetries for an overdetermined problem for the Green's function, Hardy-type inequalities, existence and non-existence results for nonlinear biharmonic equations, domain optimization in Monge-Ampère problems, hot spots for heat equation in presence of potentials, space-time convexity for parabolic problems, crystalline flow of polygonal curves, degenerate drift diffusion systems, Liouville-type theorems, eigenvalue problems for semilinear equations with critical Sobolev exponent, and singular backward self-similar solutions in parabolic problems. All papers were double-refereed according the high standards of this journal.

The Italian and Japanese mathematical school have a long history of research in PDE's and count many research groups which are active and steadily collaborate in the study of geometric properties of their solutions. For this reason, the idea of E. Yanagida and K. Ishige from Tohoku University to organize a (regularly meeting) joint conference on these topics was very much welcome. As a result of this idea, the *First Italian-Japanese Workshop on Geometric Properties for Parabolic and Elliptic PDE's* met in Sendai (Japan) at Tohoku University on June 15-19, 2009, was organized by A. Cianchi (Florence, Italy), K. Ishige (Tohoku, Japan), R. Magnanini

(Florence, Italy), S. Sakaguchi (Hiroshima, Japan), E. Yanagida(Tohoku, Japan). This meeting was a great occasion to mingle common and different experiences on the field both at senior and junior level.

The publishing of this collection of articles will certainly contribute to strengthen the already solid ties between the two schools.

We thank the editors of Discrete and Continuous Dynamical Systems, Alain Miranville and Xin Lu, who gave us the opportunity to collect these results in the present issue.

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