Curso de Doctorado
Doctorado en Ingeniería Matemática—UCM
Doctorado en Investigación Matemática—UCM
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Some Methods of Nonlinear Functional Analysis in Nonlinear Partial Differential Equations

Abstract

We intend to give a very general presentation of some methods of Nonlinear Functional Analysis which have been used extensively in the last forty years in the study of positive solutions for nonlinear elliptic equations(and then systems of reaction-diffusion type).

Our main interest is in the application of these different methods to the study of existence, uniqueness(or rather multiplicity) and qualitative properties of positive solutions to a variety of nonlinear elliptic equations arising in applications, and then we only provide the necessary tools without detailed proofs of the results we apply.

1. Introduction. Monotone methods: sub and supersolutions. The case of one equation. Uniqueness of positive solutions. Examples: logistic equations, sub-linear problems, etc. Extension to systems.

2. Topological degree. The Leray-Schauder degree. Schauder's fixed point theorem. The fixed point index. Applications to existence and multiplicity results.

3. Bifurcation theory. Local bifurcation theory. Global bifurcation theorems by Rabinowitz. Applications. Bifurcation on cones: positive solutions. Applications.

4. Continuation methods. The implicit function theorem and the Crandall-Rabinowitz local inversion theorem. Applications to convex problems.

5. Critical point theory. Minimization theorems. The Mountain Pass theorem of Ambrosetti-Rabinowitz. Applications to superlinear problems. A priori estimates by using blow-up (Gidas-Spruck). Applications: the Ambrosetti-Brezis-Cerami problem.

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Del 21 al 25 de octubre de 2013

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