

# Foreword

Several important problems arising in Physics, Differential Geometry and other topics lead to consider semilinear variational elliptic equations on  $\mathbb{R}^n$  and a great deal of work has been devoted to their study. From the mathematical point of view, the main interest relies on the fact that the tools of Nonlinear Functional Analysis, based on compactness arguments, in general cannot be used, at least in a straightforward way, and some new techniques have to be developed.

On the other hand, there are several elliptic problems on  $\mathbb{R}^n$  which are perturbative in nature. In some cases there is a natural perturbation parameter, like in the bifurcation from the essential spectrum or in singularly perturbed equations or in the study of semiclassical standing waves for NLS. In some other circumstances, one studies perturbations either because this is the first step to obtain global results or else because it often provides a correct perspective for further global studies.

For these perturbation problems a specific approach, that takes advantage of such a perturbative setting, seems the most appropriate. These abstract tools are provided by perturbation methods in critical point theory. Actually, it turns out that such a framework can be used to handle a large variety of equations, usually considered different in nature.

The aim of this monograph is to discuss these abstract methods together with their applications to several perturbation problems, whose common feature is to involve semilinear Elliptic Partial Differential Equations on  $\mathbb{R}^n$  with a variational structure.

The results presented here are based on papers of the Authors carried out in the last years. Many of them are works in collaboration with other people like D. Arcoya, M. Badiale, M. Berti, S. Cingolani, V. Coti Zelati, J.L. Gamez, J. Garcia Azorero, V. Felli, Y.Y. Li, W.M. Ni, I. Peral, S. Secchi. We would like to express our warm gratitude to all of them.

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on  $\mathbb{R}^n$

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