Abstract

Since the appearance of Newton-Rapshon's method more than 300 years ago, iterative methods have become almost unassailable in most branches of science. The development of computing has made it possible to solve problems of increasing complexity, and this has been accompanied by the need for more efficient and reliable methods. Several tools of discrete dynamics can be used to perform a dynamic analysis of methods and families of iterative methods for solving equations and nonlinear systems, with the aim of extracting information about their stability and classifying them.

In this memory a biparametric family of iterative methods is designed that contains the schemes of Ostrowski and Chun as particular cases. The convergence of the family is analyzed and extended to make it suitable for the resolution of systems of nonlinear equations. Dynamic tools are used and developed to carry out a scalar and multivariate study, and problems are solved applied to verify the results of the dynamic study. Finally, the semilocal convergence in Banach spaces of the Chun method is determined.

Chapter 2 sets out the basic concepts from which the rest of the chapters will be developed. The Newton method and its derivative free version, the Steffensen method, are transferred to the multivariable case, and the tools of complex and real dynamics are applied to them.

In the Chapter 3 a dynamic study of King's family of iterative methods is performed for the resolution of nonlinear equations. The family is applied on a generic quadratic polynomial, and members with a more stable behavior are selected.

In the Chapter 4 a biparametric family of iterative methods is designed combining the methods of Ostrowski and Chun and an extension of the family to the multivariable case is done by the use of the operator divided differences. Numerical tests are performed on academic problems and applied to confirm the theoretical results.

In the Chapter 5 a dynamic study of the Ostrowski-Chun biparametric family is made and the most stable members are applied to the solution of the Bratu equation, whereas in Chapter 6 a real dynamic study of the family is made in the multivariable case, and in this case the most stable members apply to the resolution of Fischer's equation.

In the Chapter 7 the semilocal convergence of the well-known method of Chun, member of the Ostrowski-Chun family, is proved, and the results obtained in the resolution of an integral Hammerstein-type equation are proved. Finally, conclusions and open lines of research are presented.