Continuation of zeros through iterative methods with memory

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Abstract

In many applications, it is important to understand how the roots of a function change as its parameters are varied. Continuation methods [1] are a powerful tool for exploring these changes, allowing us to track the roots of a function as we vary its parameters.

In this talk, we will discuss the basic ideas behind iterative methods [2] with memory for root continuation. We will begin by reviewing the classical methods for continuation of roots using approximations based in a prediction/correction scheme. In our setting, let $G(x, \lambda)$ be a function. The objective is to know the solution of $G(x, \lambda_f) = 0$, assuming that a solution (x_0, λ_0) of $G(x, \lambda) = 0$ is known where λ is a parameter of the model and x the unknown of the equation. In order to do so, first a prediction of the solution $(\overline{x}, \overline{\lambda})$ is computed. Then this prediction is refined in order to capture the desired solution.

In the correction step, a non-linear equation solver must be implemented. In this work, we investigate the properties that arises when using an iterative method with memory. In particular we will study the impact of the convergence radius, the number of iterates required to refine the solution and the step control on the continuation procedure compared to classical iterative methods.

References

[1] Allgower, E.L., Georg, K. Numerical Continuation Methods: An Introduction *Springer Series in Comutational Mathematics*, Springer Berlin Heidelberg, 2012

[2] Chicharro, F.I., Cordero, A., Garrido, N., Torregrosa, J.R., On the improvement of the order of convergence of iterative methods for solving nonlinear systems by means of memory, *Applied Mathematics Letters*, 104, 2020.

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