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A note on determinantal representation of a Schröder-König-like simultaneous method for finding polynomial zeros

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Abstract

Using Padé approximation, Sakurai, Torii and Sugiura derived in the paper [A high-order iterative formula for simultaneous determination of zeros of a polynomial, J. Comput. Appl. Math. 38 (1991), 387–397] the generalized iterative method of order $n+2$ for finding all zeros of a polynomial, where n is the highest order of a polynomial derivative involved in the presented iterative formula. In this note we give the determinantal representation of this method and analyze procedures for its implementation and some computational aspects.

AMS Mathematical Subject Classification (2010): 65H05.

Keywords: Polynomial zeros; Padé approximation, Simultaneous methods; Determinantal representation; Generalized iterative process.

1 Introduction

The rediscoveries of the already known formulas are not seldom in scientific disciplines; undoubtedly, they appear most frequently in mathematics. A very illustrative example was given in [1], in which it was proved that six iteration functions of general form, derived in the period from 1946 until 1999 in various ways and expressed in different forms, are actually equivalent. And yet, they are equivalent to Schröder's family of the second kind [2] derived for rational functions in 1870 by Schröder (the paper translated in English by Stewart [3]) and later extended by König [4] in 1884 for analytic functions. This family, often known in the literature as Schröder-König's family, plays the main role in this paper.

As mentioned by Kalantari in [5, Chaptrer X], *"... different formulations of an iteration function ... imply that whatever is proved for one form also applies to the other forms. These different but equivalent formulations also allow the discovery of new properties that may not be evident from other formulation."* This Kalantari's remark and his fruitful formulation of the mentioned Schröder-König's family of iterative methods considered in a determinantal form in [5], have motivated us to give a determinental representation of a powerful family of iterative methods for the simultaneous

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