

# Parallel-iterated RK-type PC methods with continuous output formulas

Cong N.H., Xuan L.N.

Faculty of Mathematics, Mechanics and Informatics, Hanoi University of Science, 334 Nguyen Trai, Thanh Xuan, Hanoi, Viet Nam

**Abstract:** This paper investigates parallel predictor-corrector iteration schemes (PC iteration schemes) based on collocation Runge-Kutta corrector methods (RK corrector methods) with continuous output formulas for solving nonstiff initial-value problems (IVPs) for systems of first-order differential equations. The resulting parallel-iterated RK-type PC methods are also provided with continuous output formulas. The continuous numerical approximations are used for predicting the stage values in the PC iteration processes. In this way, we obtain parallel PC methods with continuous output formulas and high-accurate predictions. Applications of the resulting parallel PC methods to a few widely-used test problems reveal that these new parallel PC methods are much more efficient when compared with the parallel and sequential explicit RK methods from the literature.

**Author Keywords:** Parallelism; Predictor-corrector methods; Runge-Kutta methods; Stability

**Index Keywords:** Asymptotic stability; Differential equations; Initial value problems; Iterative methods; First-order differential equations; Parallelism; Predictor-corrector methods; Runge Kutta methods

Year: 2003

Source title: International Journal of Computer Mathematics

Volume: 80

Issue: 8

Page : 1025-1035

Cited by: 1

Link: [Scopus Link](#)

Correspondence Address: Cong, N.H.; Faculty of Mathematics, Mechanics and Informatics, Hanoi University of Science, 334 Nguyen Trai, Thanh Xuan, Hanoi, Viet Nam

ISSN: 207160

CODEN: IJCMA

DOI: 10.1080/0020716031000103321

Language of Original Document: English

Abbreviated Source Title: International Journal of Computer Mathematics

Document Type: Article

Source: Scopus

Authors with affiliations:

- Cong, N.H., Faculty of Mathematics, Mechanics and Informatics, Hanoi University of Science, 334 Nguyen Trai, Thanh Xuan, Hanoi, Viet Nam
- Xuan, L.N., Faculty of Mathematics, Mechanics and Informatics, Hanoi University of Science, 334 Nguyen Trai, Thanh Xuan, Hanoi, Viet Nam

## References:

- Burrage, K., Efficient block predictor-corrector methods with a small number of corrections (1993) *J. Comput. Appl. Math.*, 45, pp. 139-150
- Burrage, K., Parallel methods for initial value problems (1993) *Appl. Numer. Math.*, 11, pp. 5-25
- Burrage, K., (1995) *Parallel and Sequential Methods for Ordinary Differential Equations*, Clarendon Press, Oxford
- Burrage, K., Suhartanto, H., Parallel iterated methods based on multistep Runge-Kutta methods of Radau type (1997) *Advances in Computational Mathematics*, 7, pp. 37-57
- Butcher, J.C., (1987) *The Numerical Analysis of Ordinary Differential Equations, Runge-Kutta and General Linear Methods*, Wiley, New York
- Cong, N.H., Parallel iteration of symmetric Runge-Kutta for nonstiff initial-value problems (1994) *J. Comput. Appl. Math.*, 51, pp. 117-125
- Cong, N.H., Explicit pseudo two-step Runge-Kutta methods for parallel computers (1999) *Intern. J. Comput. Math.*, 73, pp. 77-91
- Cong, N.H., (1999) Continuous Variable Stepsize Explicit Pseudo Two-step RK Methods, 101, pp. 105-116
- Cong, N.H., Mitsui, T., A class of explicit parallel two-step Runge-Kutta methods (1997) *Japan. J. Indust. Appl. Math.*, 14, pp. 303-313
- Cong, N.H., Mitsui, T., Parallel PC Iteration of Pseudo Two-step RK Methods for Nonstiff IVPs, , submitted for publication
- Cong, N.H., Podhaisky, H., Weiner, R., Numerical experiments with some explicit pseudo two-step RK methods on a shared memory computer (1998) *Comput. Math. Appl.*, 36, pp. 107-116
- Cong, N.H., Vi, H.T., An improvement for explicit parallel Runge-Kutta methods (1995) *Vietnam J. Math.*, 23, pp. 241-252
- Curtis, A.R., High-order explicit Runge-Kutta formulae, their uses and limitations (1975) *J. Inst. Math. Appl.*, 16, pp. 35-55
- Curtis, A.R., (1964) *Tables of Jacobian Elliptic Functions Whose Arguments Are Rational Fractions of the Quarter Period*, H.M.S.O., London
- Hairer, E., A Runge-Kutta method of order 10 (1978) *J. Inst. Math. Appl.*, 21, pp. 47-59
- Hairer, E., Nørsett, S.F., Weiner, G., (1993) *Solving Ordinary Differential Equations, I. Nonstiff Problems*, 2nd Ed., Springer-Verlag, Berlin
- Van Der Houwen, P.J., Cong, N.H., Parallel block predictor-corrector methods of Runge-Kutta type (1993) *Appl. Numer. Math.*, 13, pp. 109-123
- Van Der Houwen, P.J., Sommeijer, B.P., Parallel iteration of high-order Runge-Kutta methods with stepsize control (1990) *J. Comput. Appl. Math.*, 29, pp. 111-127
- Van Der Houwen, P.J., Sommeijer, B.P., Block Runge-Kutta methods on parallel computers (1992) *Z. Angew. Math. Mech.*, 68, pp. 3-10
- Hull, T.E., Enright, W.H., Fellen, B.M., Sedgwick, A.E., Comparing numerical methods for ordinary differential equations (1972) *SIAM J. Numer. Anal.*, 9, pp. 603-637

Download: 0829.pdf