SIDE 14.2

Contribution ID : 73

Generalization of the discrete gradient approach: improving accuracy and extending the scope of application

Thursday 22 Jun 2023 at 18:00 (00h20')

Content :

The motivation of our research is to find structure preserving discretizations of dynamical systems by developing some ideas related to the method of discrete gradients [1].
First, we recall that the discrete gradient method can be improved in two different ways without losing the energy conservation property, either by increasing its order [2], or by so-called locally exact discretizations that become extremely accurate in the vicinity of stable equilibria [3].
Second, we present our recent results concerning systems with e.g. non-linear damping or amplification (like Van der Pol oscillator or chaotic Rössler system). The approach based on the so-called
reservoirs and para-Hamiltonian formulation, developed by the co-author [4], makes possible to extend
the discrete gradient methods to a general class of autonomous ODEs (no integrals of motion are
required). Side effect of this approach is a whole slew of new geometric methods.

[1] R.I. McLachlan, G.R.W. Quispel, N. Robidoux: Geometric Integration using discrete gradients, Philosophical Transactions of the Royal Society A: Math. Phys. Eng. Sci. 357 (1998) 1021--1045.
[2] J.L .Cieśliński, B. Ratkiewicz, Discrete gradient algorithms of high order for one-dimensional systems, Computer Physics Communications 183 (2012) 617--627.
[3] J.L. Cieśliński: Locally exact modifications of discrete gradient schemes, Physics Letters A 377 (2013) 592-597.
[4] A. Kobus, J.L. Cieśliński: Para-Hamiltonian form for General Autonomous ODE Systems: Introductory Results, Entropy 24 (3) (2022) 338.

Primary authors : CIE■LI■SKI, Jan (University of Bialystok)

Co-authors : Mr. KOBUS, Artur (University of Bialystok)

Presenter : CIE■LI■SKI, Jan (University of Bialystok)

Session classification : Darboux polynomials

Track classification : --not yet classified--

Type : --not specified--