Ghosh, S.; Roy, D.


Summary: A family of multi-step tangential linearization (MTnL) techniques is developed for numeric — analytic and geometric integration of nonlinear oscillators under deterministic loading. A family of multi-step transversal linearization (MTrL) schemes is also explored and a comparison between the two linearization families is provided with a view of bringing out their relative advantages and deficiencies. The MTnL methodology essentially works through an application of the concept of MTrL to nonlinear rate equations. Different variants of the MTnL are obtained and it turns out that they are specific cases of a generalized MTnL method. Local error estimates are also provided. Moreover, higher order MTrL and MTnL methods are successfully implemented through Chebyshev nodes instead of equidistant nodes. This helps to improve accuracy even with larger step sizes. A comparison of relative errors through the MTrL and MTnL techniques consistently indicates a superior quality of approximations via the MTrL route. Whilst the usage of the tangential linearization is very common in nonlinear computational mechanics, it is demonstrated that the transversal version offers, in addition to higher numerical accuracy, an easier implementation and avoids computation of Jacobian matrices. This allows the MTrL family to be applicable even to nonlinear oscillators having $C^0$ vector fields.

MSC:
70–08 Computational methods for problems pertaining to mechanics of particles and systems
70K40 Forced motions for nonlinear problems in mechanics

Keywords:
multi-step methods; tangential and transversal linearizations; nonlinear oscillators; Chebyshev nodes

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