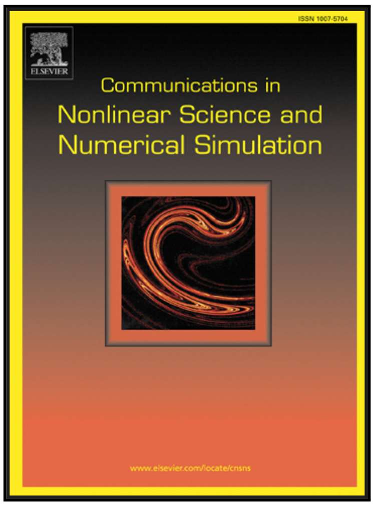

Measurement-based perturbation theory and differential equation parameter estimation with applications to satellite gravimetry

Peiliang Xu

PII: S1007-5704(17)30412-4
DOI: 10.1016/j.cnsns.2017.11.021
Reference: CNSNS 4378

To appear in: *Communications in Nonlinear Science and Numerical Simulation*

Received date: 3 August 2016
Revised date: 18 August 2017
Accepted date: 23 November 2017

Highlights

- Estimating unknown differential equation parameters has been essential in many areas of science and engineering, which has been best known as the dynamical numerical integration method in geodesy and aerospace engineering. I prove that the method, originating from Gronwall (1919) on Ann Math and currently implemented and used in statistics, chemical engineering and satellite gravimetry and many other areas of science and engineering, is mathematically erroneous and physically not permitted;
- I present three different methods to derive local solutions to the Newtons nonlinear differential equations of motion of satellites, given unknown initial values and unknown force parameters. They are mathematically correct and can be used to estimate unknown differential equation parameters, with applications ingravitational modeling from satellite tracking measurements;
- I develop the measurement-based perturbation theory and construct global uniformly convergent solutions to the Newtons nonlinear differential equations of motion of satellites, given unknown initial values and unknown force parameters. From the physical point of view, the global uniform convergence of the solutions implies that they are able to exploit the complete/full advantages of unprecedented high accuracy and continuity of satellite orbits of arbitrary length and thus will automatically guarantee theoretically the production of a high-precision high-resolution global standard gravitational models from satellite tracking measurements of any types; and finally,
- I develop an alternative method by reformulating the problem of estimating unknown differential equation parameters, or the mixed initial-boundary value problem of satellite gravimetry with unknown initial values and unknown force parameters as a standard condition adjustment model with unknown parameters.