

Heuristic Cross-Checks of Taylor Model Verified Integrators

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The behavior of nonlinear (chaotic) dynamical systems is understood by calculating flows in phase space. Stable points can emerge after iterating these flows many times, revealing significant information about the system. Calculating these flows is computationally expensive but it is important to be precise, since, due to the nonlinear behavior of the system, small variations are exacerbated with each iteration. A rigorous integrator has been developed using Taylor models and implemented in the code COSY INFINITY which integrates ODEs and PDEs rigorously (to double float precision). Presented are examples of these integrations of various point densities using an eighth-order Runge-Kutta with automatic step size control using reverse communication.

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The behavior of nonlinear (chaotic) dynamical systems is understood by calculating flows in phase space. Stable points in phase space can emerge after iterating these flows many times which reveal significant information about the dynamical systems. Calculating these flows is computationally expensive but it is important to be precise, since, due to the nonlinear behavior of the system, any imprecision is exacerbated with each iteration of the flow. A rigorous integrator has been developed using Taylor models and implemented in the code COSY INFINITY which integrates ODEs and PDEs exactly. Presented are several examples of these integrations of various precision using an eighth-order Runge-Kutta integrator with automatic step size control using reverse communication. These examples verify the results and illustrate the advantages of the rigorous integrator.