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TIME INTEGRATION IN SYSTEMS WITH INTABILITIES

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The simulation of complex systems is important in many fields of science and in real-world applications. Time integration, if not designed properly, can return misleading numerical solutions (unstable numerical solutions for what is in fact a stable system or vice versa). To understand the cause of these numerical artifacts, we construct stability charts that shed light on transitions between stable and unstable behavior simulation. Our goal is to understand the stability properties of the simulated representation of the continuous system. We will achieve this goal by expressing the trace and determinant of the discretized system in terms of the trace and determinant of the continuous system to establish stability criteria.

Finally, we propose a robust time integration scheme for nonlinear dynamic analysis with particular application to snap-through buckling of shallow arches. The algorithm is a composite method that consists of three sub-steps. Optimal values of the algorithmic parameters are determined to satisfy stability criteria and minimize damping. The proposed method is accurate, numerically stable, and efficient as demonstrated through several examples involving large deformation, large displacement and large rotation presented in this talk.