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Global Analysis of Crisis in a Non-smooth Vibration Oscillator

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Abstract: Vibration isolation design is essential for the spacecraft capture operation in the on-orbit servicing missions. And contact impact is also inevitable in this process, which can be simplified as piece-smooth ordinary differential equations and generate abundant dynamics phenomena. Therefore, it is especially important to study the contact dynamics responses. And global behavior research can be visualized the characteristics of system. Aiming to this issue, the global dynamics of a single-degree-of-freedom non-smooth mechanical system in a vibration isolation experiment is studied by using advanced numerical procedure in this paper. For this non-smooth impact and friction oscillator, the forcing frequency is used as a bifurcation parameter. We discussed the crisis phenomenon with the forcing frequency changing near the point of the grazing bifurcation. The small range of the forcing frequency decrease from 0.7954 to 0.794 and increase from 0.8000 to 0.8001 which are included the internal crisis (the attractor colliding with the internal saddle), the boundary crisis (the attractor colliding with the boundary saddle), the combined crisis (the multiple attractors colliding with the boundary saddle at the same time). Different from the chaotic transient, the crisis phenomena of steady state caused by a small range of external force frequency indicates the sensitivity of system stability. And research of global dynamics have certain significances for the reliability and stability analysis of practical engineering

Keywords: Contact Impact; Non-smooth; Crisis; Global Behavior.

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