Complexity

Special Issue on

Safety in Engineering System from a Nonlinear Dynamical Perspective

CALL FOR PAPERS

The aim of this special issue is to present recent developments, findings, and progress on fundamental theories and principles and analytical, numerical, and experimental approaches in nonlinear dynamics of engineering systems from a design perspective, contributing to the safety of these systems in a dynamic environment.

Many modern engineering systems, from nano to macro, exhibit complex nonlinear responses and bifurcation scenarios in a dynamic environment due to geometric, material, and inertial nonlinearities, nonlinear force fields such as those found in nanostructures, fluid-structure interaction, and nonlinear damping, among other sources. Unstable and saddle-node bifurcations lead to dynamic jumps and hysteresis causing stress peaks and, eventually, damage. This complexity has a strong influence on their safety and reliability.

These nonlinear phenomena include sensitivity to initial conditions and imperfections, which, together with the unavoidable uncertainties in engineering design and ambient noise, may lead to unpredictability and unwanted, even dangerous, vibrations. In addition, nonlinearities usually lead to multiple coexisting solutions, which may arise due to the underlying energy function or different types of bifurcations. The basins of attraction of these coexisting solutions may have a complex intertwining structure and fractal characteristics that increases the unpredictability of such systems.

In this context, to evaluate the practical safety, dynamic integrity measures have been proposed, as well as improved numerical techniques to evaluate these measures in high dimensional space. For this, usually reliable reduced order models are necessary. These topics have an increasing importance due to new research areas such as multistability and metamaterials.

The development of various nonlinear control techniques can improve safety and decrease the effect of uncertainties and unpredictability in nonlinear systems and control has been an integral part of many nonlinear systems. Although many of these phenomena have been studied in detail in physics and applied mathematics and have been observed in many engineering systems, little is known on their impact on the safety, reliability, and predictability of their response. A better understanding of the mechanisms and phenomena in nonlinear dynamics and the corresponding mathematical theory may improve design codes and engineering practice.

Potential topics include but are not limited to the following:

- Nonlinear dynamics and engineering nonlinearity
- Dynamic integrity measures and safe basins of attraction
- Impact of uncertainties and noise in engineering systems
- Noisy bifurcations
- Reduced order models
- Discontinuous and multibody dynamical systems
- Nonlinear vibration control techniques
- Dynamics of multistable systems and metamaterials
- Fractal engineering systems
- Quantification of sensitivity to initial conditions and imperfections
- Systems with multiple potential wells and escape mechanics
- Design and control of eminently nonlinear systems

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Papers are published upon acceptance, regardless of the Special Issue publication date.

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