

Nonlinear Dynamics of Engineering Systems

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In this lecture I will paint a broad picture of the nonlinear world and examine implications of this view on science and engineering. Through carefully chosen examples from everyday life, science and engineering I will show just how nonlinear and dynamic our world really is.

In the first part, I will define nonlinearity and nonlinear dynamics. Specifically I will focus on a class called non-smooth dynamical systems. Then I will show how such problems can be effectively modelled and analysed by low dimensional dynamical systems [1,2]. The generic complexity of non-smooth dynamics will be demonstrated by a soft impact oscillator – an archetypal model for the high frequency vibro-impact drilling [3,5].

The second part will be devoted to what we might call Nonlinear Dynamics for Engineering Design where I will present results from my recent projects, where nonlinear dynamic interactions have been used to enhance the performance of real systems and structures. I will put a special emphasis on one large project from oil and gas industry, where we have developed a revolutionary downhole drilling technology [5]. I will argue that this would not be possible in a linear and static world!

References

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3. Pavlovskaja, E.E., Wiercigroch, M. and Grebogi, C. 2001 Modelling of an impact system with a drift. *Physical Review E* **64**, 056224.
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