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CALIBRATED LOW DIMENSIONAL MODELS IN NON-SMOOTH DYNAMICS

Marian Wiercigroch[a]

[a] *Center for Applied Dynamic Research, School of Engineering, University of Aberdeen, Scotland, UK. m.wiercigroch@abdn.ac.uk; https://www.abdn.ac.uk/engineering/people/profiles/m.wiercigroch*

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Abstract. Unveiling complex behaviour in dynamical systems often relies on in-depth analysis using robust low dimensional models, which can be effectively used for parametric computational studies. The most effective way to obtain new insights is having these low dimensional models calibrated with high fidelity experiments. In this lecture I will introduce the recent advances in the field of nonlinear dynamics with a special focus on non-smooth dynamical systems, which is the newest and vastly developing area with new phenomena such as grazing induced bifurcations and a broad suite of application in science and engineering. 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. The generic complexity of non-smooth dynamics will be demonstrated by an elastic impact oscillator – an archetypal model for modelling of high frequency vibro-impact drilling. 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 projects from energy industry, where we have developed a revolutionary downhole drilling technology tested in our unique drilling laboratories. I will argue that this would not be possible without calibrated low dimensional models.