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# Data-driven nonlinear dynamics

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*Abstract*: With the availability of extensive data from simulations and laboratory and field experiments, data-driven dynamics is playing an important role in understanding the behavior of nonlinear systems. To illustrate this role, two examples are provided in this talk. The first example is related to extreme waves and the second example is related to chaotic dynamics. Freak waves or rogue waves are waves that can appear out of nowhere in oceans as well as other systems. These waves are characterized by extremely large wave amplitudes and extremely high-energy concentrations. As a representative case, time histories recorded for the Draupner wave event are considered, and based on this data and the use of the Inverse Scattering Transform, it is shown how the imminence of extreme wave formation can be picked up from the data. In the second example, time histories obtained from simulations of different prototype nonlinear systems (e.g., Lorenz'63 and Lorenz'96 systems) are considered and how this data can be used with a neural machine to forecast chaotic dynamics. Some thoughts on future directions will be presented to close the talk.

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