



## Lecture No. 63

**Czech Society for Mechanics  
and Institute of Thermomechanics, CAS**

invite you to a lecture and discussion within  
the lecture series **Institute of Thermomechanics Seminar**

# Decomposition of waves, stresses and forces in rotating disks

given by

**Prof. Izhak Bucher**

Mechanical Engineering, Technion, Haifa, Israel

The present talk will focus on rotating disk dynamics by introducing a novel signal-processing method geared towards capturing the dynamics of such systems. The method exploits multiple sensors and is thus capable of handling spatially complex transient dynamics. Rotating disks identification methods rely on special features of rotating elements, e.g. cyclic-symmetry, gyroscopic effects, directional whirling and circumferentially traveling deformations, all have a physical meaning and are exploited in the proposed approach.

The 'eyes' of 'Smart Rotating Machines' are the sensors and the accompanied, real-time signal processing methods play the role of a 'brain' in the assessment of measured data. Indeed 'smart' also means combining advanced sensing capabilities with an electronic brain which is aware of the underlying physics laws to which the model obeys. At the moment, it seems that the pendulum leans heavily towards numerical modeling. Finite Element models are the basis for analysis and design, while testing and measurements provide only limited verification means for some of the model parameters due to poor deployment and simplistic signal processing procedures. The new method narrows the gap between models and experiment and it illustrates what can be gained when they are added.

The presentation will highlight the advantages of model-based signal processing over past and presently used methods and will try to point to a path leading from older methods and techniques towards present, state-of-the-art methods and further into the future where smart machines will have 'eyes' and 'brains'.

Specifically, the presentation will describe spatial, temporal and directional decomposition of rotating machine vibrations during rapid rotational accelerations. Real time signal processing methods that exploit Hilbert transform based decompositions; directional order-tracking and time-frequency maps will be demonstrated via simulations and experiments. The spatial and temporal decomposition method enables a Smart-Machine to assess true stress and strain on parts rotating relative to an array of sensors and thus help to enhance safety.

One additional topic will be briefly shown if time allows: active detection of imbalance for high-speed modes, using slow rotation data.

**The lecture will be held on Thursday, March 21, 2019 at 10:00 in the building  
of the Institute of Thermomechanics (lecture room B), Dolejškova 5, 182 00 Prague 8**

Contact persons: Radek Kolman, Hanuš Seiner, Luděk Pešek