

## Conférence semi-plénière

# A Brief History of Coupling and Nonlinearity in the Vibration of Rotating Machines (1965-2015)

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### Abstract:

This lecture presents a high-level overview of 50 years evolution of vibration phenomena in high-performance Rotating Machinery and will focus on philosophical and strategic aspects more than highly-detailed technical tactics. From the very beginning, the vibration characteristics were studied both theoretically and experimentally, component by component and then assembled or ‘coupled’ to configure the final machine in service. In the earlier days, greater reliance had to be placed on the experimental procedures because mathematical models as we know them today simply did not exist and so much was learned about the physics of machinery dynamics by working with the real hardware, rather than idealised models of it. As a result of this approach, the real-world issues of damping, of rotational degrees of freedom and the inevitable occurrence of nonlinear behaviour were all encountered much earlier than would normally be the case in a more analytical approach where one starts by assuming these complexities do not exist. The talk is based on many years’ experience with high-performance turbomachinery and will use specific examples to illustrate various phenomena related to coupling and nonlinearities in: bladed disc assemblies; friction blade dampers; whole engine casings; rotor-stator rubs and other interactions; magnetic bearings; rotor internal damping and will include examples of ‘apparently impossible’ measurements on unstable and nonlinear rotating components.

**Keywords : Rotating machinery vibrations, modal testing, coupled structure dynamics, nonlinear structure dynamics**

### Biography:

David Ewins’ research interests span a wide range of structural dynamics topics, and include efforts to bring about an integration of the experimental, numerical and theoretical methods that represent the whole spectrum of essential technologies. Currently, there is a major focus on the appropriate representation of joints and interfaces in the dynamic analysis of real engineering structures and he is Chair of the ASME Research Committee established to co-ordinate international efforts in this area.

His industrial application areas are primarily aerospace and defence with a longstanding collaboration with Rolls-Royce. He has served on several advisory boards, including the Rolls-Royce Materials

Manufacturing and Structures Advisory Board (MMSAB), the Conseil Scientifique at INSA de Lyon, as Chair of the EU Clean Sky Scientific and Technological Advisory Board (STAB), and others. He is a Fellow of the Royal Society and of the Royal Academy of Engineering and in 2015 was awarded the ASME J.P. Den Hartog Award for lifetime contributions to the teaching and practice of vibration engineering