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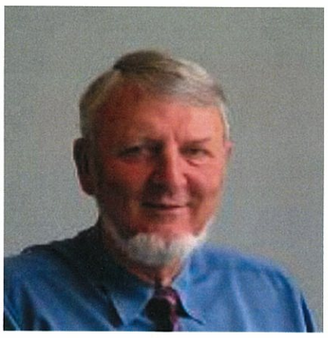

Robert .B. Randall
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"Vibration Based Diagnostics of Gearboxes"

Friday, October 30, 2009
9:30 to 11:30 AM
NSEC (LARP), IMMS Suite 101

Abstract: Very powerful signal processing techniques are now available for separating and extracting the signatures of individual components in complicated gearboxes, such as those used in helicopters and wind turbines. Even though these have multiple shafts operating over a very wide range of speed and frequency, each supported by two bearings, techniques are now available, firstly for separating the (deterministic) gear signals from random signals, including those from the bearings. The latter can be classified as second order cyclostationary, thus allowing their separation from stationary random signals, such as due to turbulence, and from other cyclostationary signals with different cyclic frequency.

The gear signatures can normally be separated from each other by time synchronous averaging (TSA), even for the planet gears, which are moving with respect to fixed transducers, and then the distinction can be made between local and distributed faults. A recent advance is the possibility of distinguishing tooth root cracks (TRCs) from spalls, both localised faults, but with very different prognoses.

A recently developed semi-automated procedure for diagnostics of rolling element bearings has proved to be effective for applications as widely diverse as high speed gas turbines and the main bearing of a radar tower (12 s period) as well as helicopter gearboxes. In addition to the separation of gear and bearing signals, it involves minimum entropy deconvolution (MED) to remove transmission path smearing, spectral kurtosis (SK) to find the most impulsive frequency band, and optimised envelope analysis for diagnosis.

Special problems are encountered with the gearboxes of wind turbines, because of the wide load variation which occurs over relatively short time periods, and the sensitivity of gear vibration signals to the load. This can give problems with the TSA, but even in such a case, a recent example showed that SK was able to indicate a developing ring gear TRC a long time in advance, even though it was not detected by other standard techniques.

Biography: Bob Randall is a visiting Emeritus Professor in the School of Mechanical and Manufacturing Engineering at the University of New South Wales (UNSW), Sydney, Australia, which he joined as a Senior Lecturer in 1988. Prior to that, he worked for the Danish company Bruel & Kjaer for 17 years, after ten years experience in the chemical and rubber industries in Australia, Canada and Sweden. He was promoted to Associate Professor in 1996 and to Professor in 2001. He has degrees in Mechanical Engineering and Arts (Mathematics, Swedish) from the Universities of Adelaide and Melbourne, respectively. He is the invited author of chapters on vibration measurement and analysis in a number of handbooks and encyclopedias, and a member of the editorial boards of three journals including Mechanical Systems and Signal Processing and Trans. IMechE Part C. He is the author of more than 190 papers in the fields of vibration analysis and machine diagnostics, and has successfully supervised twelve PhD and three Masters projects in those areas. Since 1996, he has been Director of the DSTO (Defence Science and Technology Organisation) Centre of Expertise in Helicopter Structures and Diagnostics at UNSW.

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