# PREDICTION OF CHATTER IN TWIN DISC TRIBOMETERS WITH MODE DECOMPOSITION TECHNIQUES

**Surya Kannan Peesapati [a*], Josef Prost [a], Georg Vorlaufer [a], Markus Varga [a], Carsten Gachot [b]**
*surya.peesapati@ac2t.at
[a] AC2T research GmbH, Viktor-Kaplan Straße 2/C, 2700 Wiener Neustadt, Austria
[b] Technische Universität Wien, Institute of Engineering Design and Product Development. Lehargasse 6, Objekt 7, 1060 Wien, Austria

## KEYWORDS

***Wear; Machine learning; Artificial Intelligence; Experiments in Tribology; Mode decomposition***

## ABSTRACT

Chatter is a kind of self-excited, unstable vibrations in almost all machining processes. Chatter can result in several negative effects such as poor surface quality, decreased removal rate, accelerated tool wear, high noise level, and environmental consequences in terms of materials and energy [1, 2]. Existing studies have been focusing on the pre-chatter stage, developing various techniques to detect, predict, and suppress the chatter [3, 4]. In real applications, chatter will inevitably happen under certain cutting conditions, generating chattermarks on the workpiece surface. It is noted that the chattermarks will easily induce chatter again, resulting in worse surface quality.

In order to meet the demand of real-world production, it is necessary to detect the onset of chatter before chattermarks appear on the workpiece. We thereby use mode decomposition techniques - Empirical, Variational and Bivariation Empirical mode decompositions (EMD, VMD, and BEMD). The main objective of these is to decompose the real valued signal into discrete number of sub-signals (modes) which isolates the high frequency oscillations by identifying local minima and maxima in the signal.

Feature sets (phase shift, peak to peak, standard deviation etc.,) of true intrinsic mode functions (IMFs) were calculated which were further used for training a machine learning model, detecting the different vibration states followed by the prediction of chatter marks. This prediction model based on mode decompositions and random forest shows its feasibility for chatter detection and identification with better accuracies.

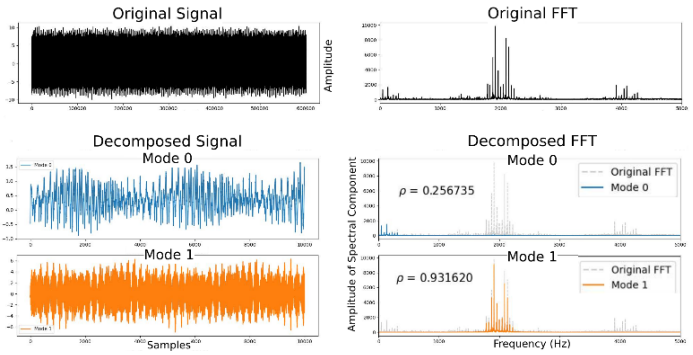


Fig.1 Decomposed Modes of Twin Disc Machine Vibration Data

## REFERENCES

[1] Amor M. and Claus W., Monitoring a deep hole drilling process by nonlinear time series modeling. Journal of Sound and Vibration, 321(3–5):620–630, Apr 2009. ISSN 0022460X.

[2] Kondo E., Ota E., and Kawai T., A new method to detect regenerative chatter using spectral analysis, part 1: Basic study on criteria for detection of chatter. Journal of Manufacturing Science and Engineering, 119(4A):461–466, Nov 1997. ISSN 1087-1357, 1528-8935.

[3] Chen C.K. and Tsao Y. M., A stability analysis of regenerative chatter in turning process without using tailstock. The International Journal of Advanced Manufacturing Technology, 29(7–8):648–654, Jul 2006. ISSN 0268-3768, 1433-3015.

[4] Guillem Q. and Joaquim C., Chatter in machining processes: A review. International Journal of Machine Tools and Manufacture, 51(5):363–376, May 2011. ISSN 08906955.