

STATE SPACE FORMULATION OF TFEA
&
UNCHARTED ISLANDS OF INSTABILITY IN MILLING

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ABSTRACT

A new approach is developed to examine the stability of delay differential equations that builds upon the previous work in temporal finite element analysis. In contrast to the results of previous work, which could only be applied to second order delay differential equations, the present work is on developing an approach which can be applied to a broader class of systems that may be written in the form of a state space model.

Conclusive evidence that isolated islands of chatter vibration can exist in the stability charts of milling processes is provided. Modeling efforts consider the influence of the tool helix angle to obtain the aforementioned results and develop an analytical force model with three piecewise continuous regions of cutting. Theoretical predictions are validated by a series of experimental tests that confirm the isolated island phenomenon.