Research Contributions
with Former Students and Collaborators

It is believed that the research of Professor Ma and his collaborators over the years has advanced the methodology of systems analysis and design. Only time can tell what impact, if any, that their research has or will make. In a description of past accomplishments, there are three problem areas to which their contributions are particularly noteworthy.

I. Generalization of Modal Analysis

Together with his students, the method of modal analysis was extended to decouple any linear system in real space. The resulting decoupling transformation is invertible and generally nonlinear. As a byproduct, a damped linear system that possesses three symmetric and positive definite coefficients can always be recast as a series of independent single-degree-of-freedom systems.\(^*\) This extension has been applied to streamline design and optimization.

II. Rotating Flow of Thin Films

Together with former students, a new theory of viscous flow of thin layers over a rough rotating surface was developed. Surface roughness was represented as a stochastic process and, using Monte Carlo simulation, it was shown theoretically for the first time that surface roughness played a dominant role in retaining a film on a rotating surface against centrifugation. The theory has been applied to spin coating and lubricant retention.

III. Nonlinear Random Vibration

There are few exact solutions to nonlinear systems. In collaboration with other scholars, exact steady-state solutions were constructed for a class of nonlinear stochastic systems.\(^{**}\) In addition, relative sensitivity of each control parameter of the differential model of hysteresis (nonlinear damping) was assessed for the first time.

Representative Publications


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\(^*\) This extension of modal analysis has recently been included in the following popular textbook:


\(^{**}\) A discussion of these new and exact solutions is given in the following books:


\(^{***}\) Web of Science All Databases citation index


