OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Overview of the Dynamic Systems Analysis And Simulation

Dynamic Systems Analysis and Simulation

Group Facts: Many Group members worked on the Department of Energy Gas Centrifuge Program in the 1970s and '80s. This experience forms the basis for our rotating machinery expertise.

Sponsors: The USEC American Centrifuge Project is our largest sponsor. Support areas include thermal modeling, performance modeling, gas testing, rotor dynamic analysis and balancing, and small-article spin testing.

Group Members:
• Brian Damiano (Leader)
• Regina R. Parks (Admin. Support)
• William J. Allington
• David L. Beshears
• Ethan Coffey
• Howard Haynes
• Kathy Hylton
• Philip A. Jallouk
• Rick W. Jones
• Claire Luttrell
• Larry D. Phillips
• Brian Tobler
• Raymond Tucker
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Dynamic Systems Analysis and Simulation (DSAS) is an applied research group that works primarily with mechanical systems. With extensive experience in rotating machinery applications, we have performed modeling, simulation, and rotor balancing and developed diagnostic tools for predictive maintenance. These applications require expertise in the areas of system modeling and simulation, signal processing, and data collection and analysis methods. Additional DSAS expertise includes thermal modeling, nonlinear time series analysis, wavelet analysis, reliability analysis, and the design and performance of unique thermal measurements. DSAS also maintains a significant mechanical design capability.

U.S. commercial centrifuge enrichment plant.

Science and Technology Focus Areas

• Rotor dynamics and balancing.
• Electrical Signature Analysis.
• Predictive maintenance and diagnostics.
• Mechanical system modeling.
• Signal processing.
• Mechanical design and fabrication support.
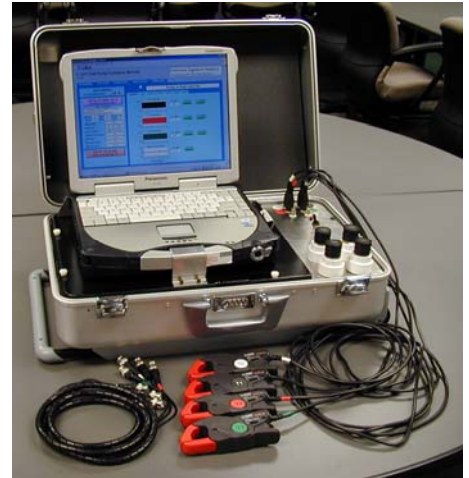
Air Force C-141 Fuel Pump Condition Monitoring System.

Facilities and Capabilities

• Dynamic Systems Diagnostics Laboratory.
• Matlab-based rotor dynamics and supercritical rotor balancing codes.
• B&K Pulse vibration data acquisition and analysis system.
• Proficiency in Labview, Matlab, Mathcad, Visual Basic, Fortran, C, and AutoCad.

A History of Tangible Achievements

DSAS Group members have developed techniques that have solved challenging industrial problems.

• DSAS developed the algorithms and codes used to balance the gas centrifuges used in the USEC American Centrifuge Project and

transferred this technology to USEC and its partners. In addition, DSAS members developed the rotor dynamics codes used to support rotor design and balancing and played a major role in rotor design, suspension design, small article spin testing, performance modeling, thermal modeling, reliability studies, and full machine test design analysis.

Second Flexural Mode Shape

normalized deflection magnitude
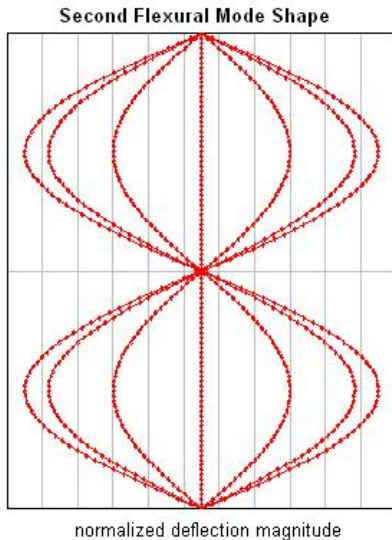
Predicted second flexural mode shape.

- DSAS members pioneered Electrical Signature Analysis (ESA), a method to extract mechanical information from motor or generator electrical measurements without interfering with the actual operation of the equipment.

- Building on its expertise with ESA, the group developed portable briefcase-size units for monitoring fuel pumps and generator bearings in military aircraft, helping to ensure our country's combat readiness and security.

- In the signal processing arena, DSAS has developed

  — the Enclosed Space Detection System, a wavelet-based system for detecting a person hiding in an enclosed space, such as a vehicle;

  — speaker recognition and voice enhancement techniques; and

  — encryption methods based on nonlinear time series analysis methods.

Contact Information

To learn how you can leverage our group's capabilities to solve your mechanical and systems problems, please contact Brian Damiano (bdz@ornl.gov) at 865-574-5541.