

Mission

Mechanical Solutions, Inc. (MSI) provides high-value engineering services and select products to industrial and government customers. MSI can be relied on to:

- » Develop and provide advanced 3D imaging software and hardware products for missile tracking and munitions characterization applications.
- » Deliver practical solutions via specialized troubleshooting services, and a secure distance communication product.
- » Supply advanced diagnostic solutions for machinery & system critical service applications.
- » Develop pioneering energy recovery products and services for commercial and Naval (Military Sealift Command) Applications.

Vision

Maintain the core company and tools consistent with superior customer and market response, capable of strong technology innovation. Pursue work in both the commercial and government sectors.

Continually invest in employees and tools in order to maintain a competitive edge. Spin off companies as innovative technologies mature via partnerships, JVs, licenses, or employee ownership. Overall, foster mutually beneficial relationships between MSI staff and our partners.

Goal

Determine and deliver practical and effective engineering solutions that respect budget realities.

Capabilities

Design, analysis, troubleshooting, and testing: MSI provides high value engineering services to organizations where machinery downtime quickly adds up to millions of dollars of lost profits or reduced mission readiness.

Technical capabilities in the following areas: vibration, acoustics, thermal, flow/CFD, fluid structural interaction, stress, deformation, penetration, shock/blast, high-speed video, mechanical/system design, spin-pit testing, prototype manufacturing, lab and field testing, and 3D imaging.

Top-of-the-line analysis and testing tools & capabilities. Engineering capabilities equal to or exceeding those at large organizations.

Products

- » Distance Communication Maintenance System (DCoMS) – Connects remote field technicians with shore-site/headquarter-based experts.
- » Sentry™ - Physics-based rotating machinery health management including auto-diagnostics to provide answers rather than simply more data.
- » Blade Fatigue Detection (BFD) System - Continuous turbine engine blade health monitoring using radar.
- » Air lubricated foil bearings enabling higher speed and more efficient turbomachinery.
- » Waste-to-energy turbomachinery including the Turbonetics Energy Independence (TEI) turbine generator.
- » Automated Warhead Characterization System (AWCS), Portable Missile-Miss Distance Information System (PMMDIS), Missile Attitude Detection Device (MADD)

Company History

- » **1996** MSI founded as a NJ S-Corporation design, analysis, and troubleshooting of rotating machinery & systems
- » **2000** First spin-off company as a result of a Navy SBIR project
- » **2006** Opened offices in MD & NH. Initiated development of Sentry™ and BFD systems.
- » **2007** Started fluids engineering division
- » **2009** Opened facility in Albany, NY continuing the TEI generator product & foil bearing development and manufacturing capability.
- » **2011** and **2013** Opened Indianapolis and Denver offices
- » **2016** Sentry™ exceeds \$8M in Phase III SBIR commercialization



Products

Sentry™ Machinery Diagnostics System

- » Physics-based, advanced diagnostics/prognosis
- » For critical service rotating machinery and valves
- » Stand-alone or augment existing monitoring
- » Custom solutions – example, smart system for a Navy skid-mounted filtration system.

Distance Communication Maintenance System (DCoMS)

Being developed for the Navy but with broad industrial applications, the portable DCoMS enables a shore-site subject matter expert to actively support important maintenance related activities aboard ships. DCoMS virtually puts the remote expert in the machinery plant via a secure satellite (or cell) connection requiring extremely low bandwidth for effective audio, video, and data communication. Provides for more rapid response to critical problems, reduces excessive travel, and improves utilization of high-value experts.

Advanced Non-Contacting Stress Measurement – Blade Fatigue Detection (BFD) System

Turbine blade failure is consistently ranked as a high risk for both aircraft engines (the majority of Class A&B engine-related mishaps) and non-availability U.S. events in U.S. power plant steam turbines and aeroderivative gas turbines. By monitoring the blade motion with a patented microwave radar measurement technique, MSI's BFD System:

- 1) reduces the sensor count (solving the cost and complexity problems) and 2) directly calculates the blade vibration frequency, modal displacement, and vibratory stress (solving the accuracy problem with current methods).

3D imaging

MSI develops the software that can leverage emerging high-speed camera products to more accurately track and characterize objects such as missiles and munition fragments.

Engineering Services

Mechanical Solutions, Inc. (MSI) is a 40+ person engineering design, analysis, testing, and troubleshooting company with a particular focus on critical service pumps, compressor, and turbines. Application experience includes turbines, rocket engine turbopumps, waste water pumps, environmental control units, micro-turbines, HVAC compressors, fans, hydraulic turbines and consumer products.

1. Design and prototype manufacturing

Flow path aerodynamic and mechanical design and analysis, or complete machine design to support new product development or retrofits. Flow path analyses using Computational Fluid Dynamics (CFD) programs. Examples: Complete pump design for a nuclear application, high-pressure boiler feed pump for a shipboard application, aero-mechanical redesign of steam turbine blade rows, several hydraulic turbine designs, and critical pump flow path redesigns. The goal is to deliver a design that meets performance, efficiency, and operating life/reliability requirements.

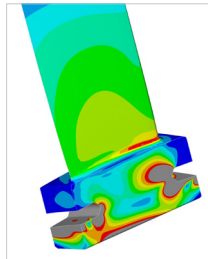
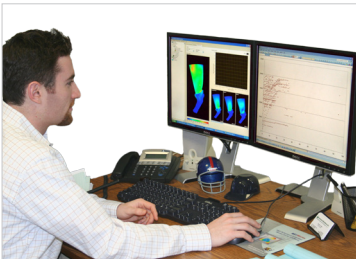
2. Machinery problem solving

MSI's reputation is based on its ability to solve high profile rotating machinery problems. MSI uses specialized test and analysis techniques to help resolve problems without resorting to expensive "trial and error" problem solving. Examples include aeroderivative gas turbines; a boiler feed pump for a concentrated solar plant; steam turbines; critical service pumps, fans, valves; and gear boxes.

Products

Rotordynamics, Bearings & Seals

- » Rotor Stability
- » Shaft Critical Speeds
- » Rotor Forced Response
- » Power Train Torsional Analysis
- » Bearing & Seal Coefficients
- » Squeeze Film Dampers
- » Multi-rotor Systems with Flexible Supports
- » Hydrostatic Bearing Analysis
- » Foil Bearing Design and Manufacture

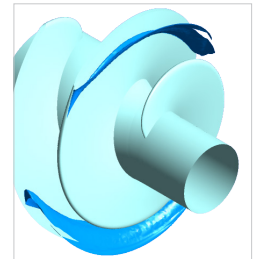


Finite Element Analysis

- » Linear and Non-Linear Capability
- » Stress, Fatigue, and Failure (LCF & HCF)
- » Vibration and Natural Frequency (incl. Bladed Disc)
- » Heat Transfer - Steady and Transient
- » Acoustics
- » ASME Boiler & Pressure Vessel Code Sect. III or VIII
- » Cracking, Fracture Mechanics
- » 3-D Contact w/ Friction
- » Plastic Flow & Creep

Flowpath Design & Analysis

- » Steady state and transient CFD analysis
- » Fluid/Structural Interaction
- » Multi-component and stage CFD analysis
- » Axial and radial pump design
- » Very low Ns pump design
- » Axial and radial turbine design
- » Low NPSH inducer design
- » Low noise fan specialists



Specialized Troubleshooting & Testing

- » Advanced vibration analysis and diagnostics
- » Operating deflection shape (ODS) testing
- » Time-Averaged Pulse (TAP™) "bump" testing during operation
- » Dynamic pressure testing
- » Strain gauge testing
- » Spin pit with high temperature and mode excitation capability
- » Blade Fatigue Detection (Advanced NSMS) – test stands and in the field



Customers

Government

- » Naval Aviation Systems Team
- » **Propulsion & Power Engineering
- » Office of Naval Research
- » NASA
- » Marines
- » U.S. Air Force
- » Naval Sea Systems Command
- » The U.S. Army Armament Research, Development and Engineering Center

Private

Equipment end-users, architect/engineers, and equipment manufacturers and service providers

- » Dresser-Rand
- » Colfax
- » ITT Corporation
- » Curtiss-Wright Corporation
- » ExxonMobil
- » General Dynamics
- » Bechtel
- » Florida Power & Light
- » Alion
- » Explorer Pipeline
- » Public Service Enterprise Group
- » York by Johnson Controls

Head Set with Camera

Machinery Space Server (MSS)

Portable Machinery Space Kit

Machinery Space Laptop (MSL)

DCoMS Distance Communication Maintenance System

Mechanical Solutions, Inc. (MSI) is a recognized leader in troubleshooting and solving problems in critical service rotating machinery systems. While our engineers continue to build up a tremendous amount of frequent flier miles, a more efficient way for troubleshooting problems, even in the most remote power plant, off-shore oil rig, ship, or mining operation, is being developed. The Naval Sea Systems Command (NAVSEA) is funding the initial development work as Navy shore-site subject matter experts (SMEs) must travel great distances to support fleet problems. In just one example, a Navy SME traveled 3 million commercial air miles (not including shore to ship travel) over an 8 year period.

The portable DCoMS kit consists of up to three cameras (head-mounted, inspection and general area), a noise-canceling headset, and a ruggedized machinery space laptop (MSL), all of which locally connect wirelessly to the portable machinery space server (MSS) (alternately, the MSL can serve as the MSS). The MSS provides a secure, web-based interface from the remote plant or shipboard machinery space to the expert via satellite or cell network. The expert uses their standard laptop or desktop computer to access the DCoMS secure webserver. No MSI software is required on the expert's computer.

Key challenges addressed by DCoMS: a) Cyber-security is addressed by following the latest Information Assurance (IA) requirements given by the US Navy; and b) low bandwidth – the system enables effective maintenance related audio/text/video/image communication at a bandwidth of 128Kbps (not much more than early dial-up modem bandwidth) with latency of about 1000 milliseconds.

Product development status: MSI achieved a key milestone in November 2015 with the receipt of a Interim Authority to Test (IATT) and a successful test aboard the Navy's Self Defense Test Ship (SDTS). While development continues, MSI is using the prototype system for its own field troubleshooting work. Are you interested in tracking this effort so your organization can also use scarce technical experts more efficiently for field work? If so, contact Eric Olson at eric.olson@mechsol.com, (973)326-9920 x125.



A video freeze-frame view from the SME's computer screen in his office while the SME and remotely located technician were discussing a pump's vibration level just prior to shutdown. The upper right photo is the view from the technician's head-mounted camera as he looks at the machinery space laptop (MSL). The lower right view is the upper part of the still frame bearing inspection image that had already been sent to the SME.



Left - A video freeze-frame view from the shore-site SME's computer screen as the SME ensures that the accelerometers for the vibration measurements are in the correct location prior to pump start-up. Right - dial indicator inspection photo previously sent to the SME during the alignment process.