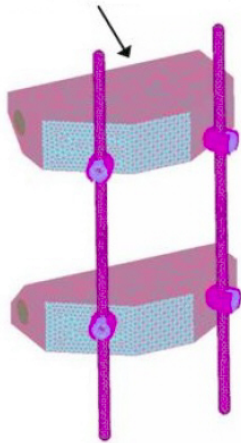
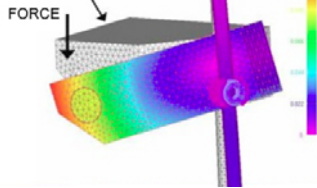


## Medical Case Study (Mechanical Solutions, Inc. – Spinal Implant Fatigue Stress Analysis)

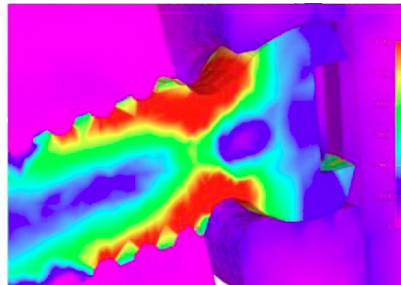
NE/NASTRAN FINITE ELEMENT ANALYSIS MODEL OF SPINAL IMPLANT TEST SAMPLE



DEFLECTION OF LOADED, SYMMETRIC FINITE ELEMENT MODEL



VON MISES STRESS DISTRIBUTION SHOWN ON CROSS-SECTION OF A SCREW WITHIN THE LOADED SPINAL IMPLANT TEST SAMPLE



A manufacturer of spinal implant system had developed a new external-fixation clamping device to the stage that it was ready to undergo required compression-fatigue testing. Shortly before the testing commenced, the company requested that MSI ([www.mechsol.com](http://www.mechsol.com)) predict through finite element analysis (FEA) where the system initially would fail, and at what magnitudes of load.

MSI simulated a typical test construct's operation during a complete load cycle using the FEA program NEi Nastran. MSI used an iterative nonlinear analysis technique to evaluate the device realistically. To replicate the external loads and constraints accurately, the detailed NEi Nastran model encompassed relevant portions of the test fixture along with the spinal implant test sample. An assembly preload effect was included to represent the internal clamping forces that held the implant system's parts in position during the test. Contact elements that accounted for sliding friction were located at the component interfaces to reveal their interaction throughout the load cycle. Modeling the plasticity of the titanium alloy used to manufacture the components provided sufficient accuracy in a nonlinear large-deflection solution.

MSI scrutinized the predicted maximum component stresses from the NEi Nastran results and identified where the fatigue failure within the proprietary device was likely to initiate. By evaluating mean and alternating stresses with a modified Goodman diagram, MSI predicted maximum loads that would allow the implant to satisfy the fatigue test's criterion, completing 5,000,000 load cycles without failure. MSI's analysis also revealed, otherwise difficult to observe, details of the complex component interactions within the assembly, allowing edge details and tolerances to be modified in a manner that ensured the device's success vs. FDA criteria. Fatigue testing performed by the manufacturer corroborated MSI's analytical findings, and showed that both the initial fatigue failure location and the amount of load that would lead to failure were forecast accurately. Thus MSI's FEA analysis expertise could be applied successfully as a tool to reduce mechanical testing costs, and to evaluate and refine spinal implant designs.

**NEi Software, Inc.** is aggressively focused on commitment to the customer. Detailed documentation, customized on-site training, and comprehensive technical support ensures that you will see immediate return on your investment.

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