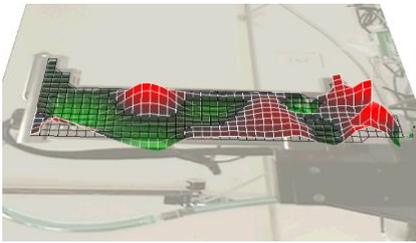


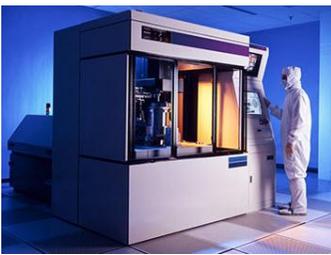
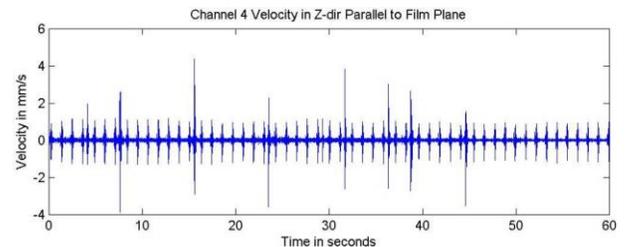
Noise and vibration are concerns in nearly any factory. In high-tech settings, however, noise and vibration can create major problems with human as well as machine productivity. In some cases, tools can generate vibrations that affect the tools themselves. This can lead to low throughput, high defect rates, and unintended process variability. We can help improve the noise and vibration performance of your tools, whether they are sources, sensitive receivers, or both. Below we describe some of our work on advanced technology tools; names of manufacturers and products are omitted for confidentiality.



**Material Deposition Tool** (high-tech manufacturing): noise reduction for a precision-deposition machine. A high-frequency electro-mechanical device inside the tool created loud and annoying sounds. The vendor was concerned that poor sound quality would negatively affect customer perception and that noise levels were dangerously close to OSHA noise regulation limits. We used a special non-contact

scanning laser vibrometer to visualize (above) the motions of surfaces connected to the deposition head. We were able to identify specific components that were radiating sound, allowing us to assist in the redesign of those parts to reduce sound radiation.

**Laser Ablation Tool** (drug delivery manufacturing): characterization of onboard vibration. A pharmaceutical company was developing a precision laser-ablation tool used in the mass-manufacture of a drug delivery system. We were asked to characterize [relative motion](#) between an objective and target in a prototype tool as a proxy for process variability. These data were used to inform the design and specification of scaled-up tools for a new factory line.



**Wafer Inspection Tool** (semiconductor manufacturing): vibration and noise consulting for a new optical metrology/inspection tool. Relative motion inside the tool was creating false-positive defect detections and other problems. We helped diagnose sources of motion based on detailed data collection inside the tool. Noise from turbulence due to a poor fan inlet condition was identified as a major contributor to micro-vibration levels within the tool.

**Photovoltaic Process Toolset** (alternative energy manufacturing): noise control for a major solar energy collector manufacturer. A new factory suffered from high noise levels. While not quite exceeding OSHA regulations, noise levels at the factory floor were uncomfortably high. The tools were first-of-their-kind and had not been designed to reduce noise emissions. We performed factory-wide noise surveys of the new tools and helped design affordable *in-situ* screening and absorption mitigations to reduce noise levels.

