ISSUE
109
Monte Carlo

LathropNEWS

this issue

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If you have product development challenges...

We have the solutions.

Lathrop has a seasoned staff of designers and engineers in the fields of:

- Mechanical Engineering
- Systems Engineering
- Electronics Design
- Optics Design
- Industrial Design & Human Factors
- Software & Firmware Development
- Project Management

Product Expertise

Medical Devices

Biotech Instruments

Diagnostic Instruments

Production Automation

Consumables / Disposables

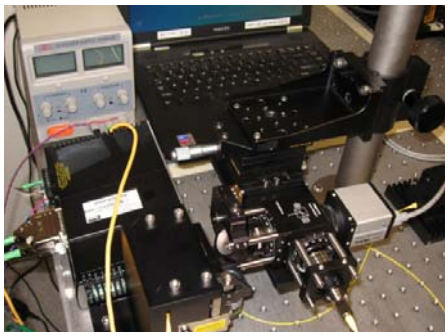
Consumer Products

ISO 9001 CERTIFIED

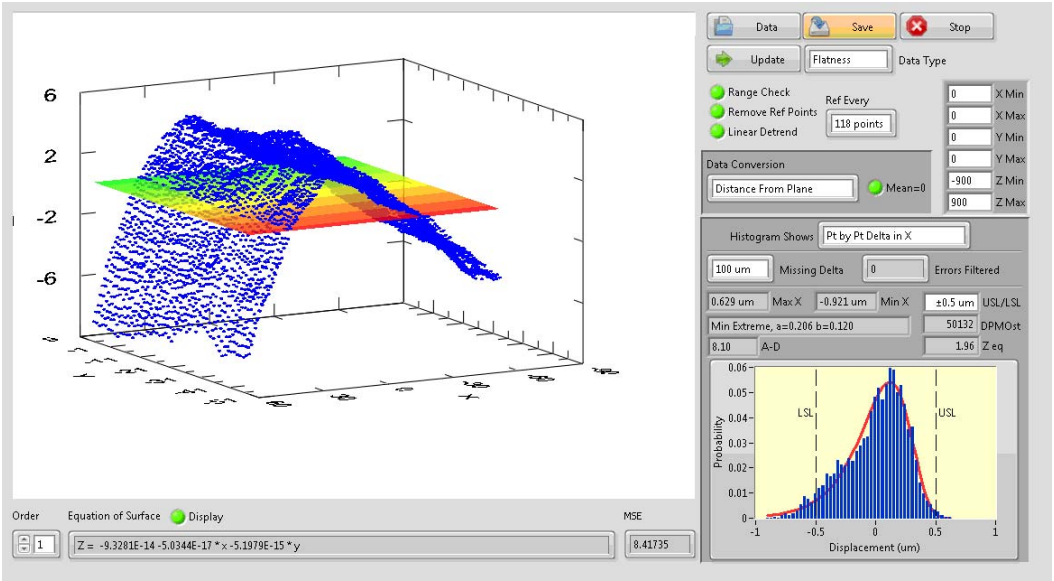
Tolerance Analysis: Don't Leave it to Chance

Articles By Leonard Kaufer, Program Manager at Lathrop Engineering

Cutting edge instruments have exacting requirements that may be difficult to meet using standard tolerance techniques. Lathrop Engineering has the experience and tools to insure that tight requirements do not jeopardize your COGs and incoming inspection. A statistical simulation may be just the tool to keep your tolerances in check.



Testing set-up using Shack-Hartmann Sensor

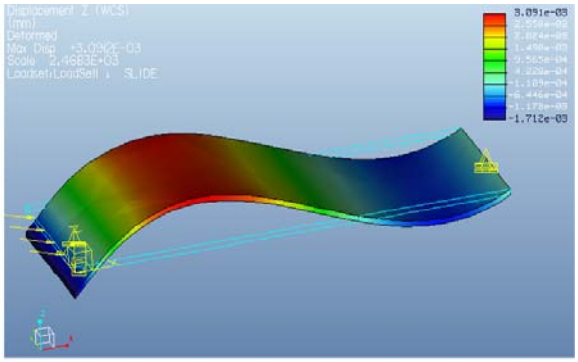


Automated Data Analysis

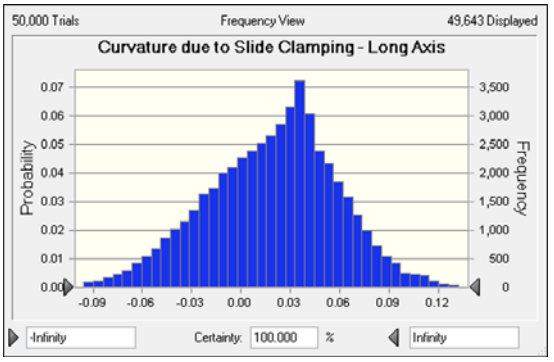
Tools and Expertise for Engineering Success

Having the right tools and knowing when and how each should be used is critical to efficiently arriving at the appropriate engineering solutions in a timely manner. Lathrop has experience and expertise in the following analytical tools:

- Statistical Simulations (e.g., Monte Carlo simulation)
- Finite Element Analysis (FEA)
  - Structural Analysis
  - Modal Analysis
  - Thermal Analysis
- Computational Fluid Dynamics (CFD)
  - Fluid Flow
  - Airflow
  - Thermal Analysis
- Optical Modeling (ZEMAX)
- Mathematical Modeling
- Gage R&R Studies



FEA analysis of displacement of a glass slide when clamped



Distribution based upon the combination of several complex calculations

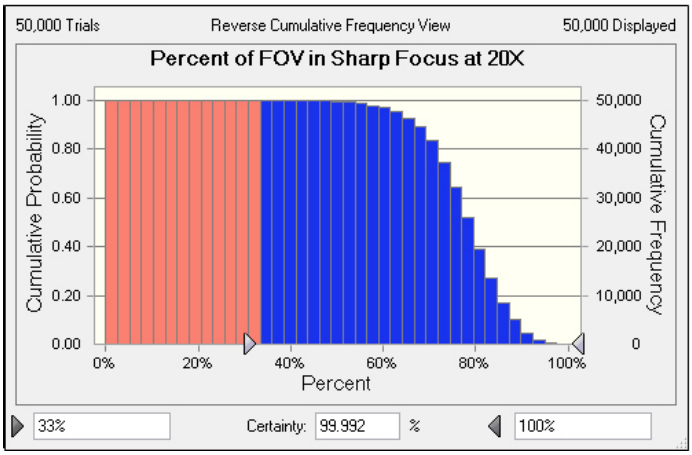
Tolerance Analysis Case Study

Lathrop recently conducted an evaluation of a prototype high resolution imaging system. Each prototype system provided excellent image quality. There was only one problem: A quick analysis of the tolerance stack suggested that the design should never work. In a traditional worst-on-worst case tolerance analysis, a well designed system will work even when all components are at the worst case limit of their allowable tolerance. In the real world it is very rare to have every element of the system at the same extreme end of the tolerance range.

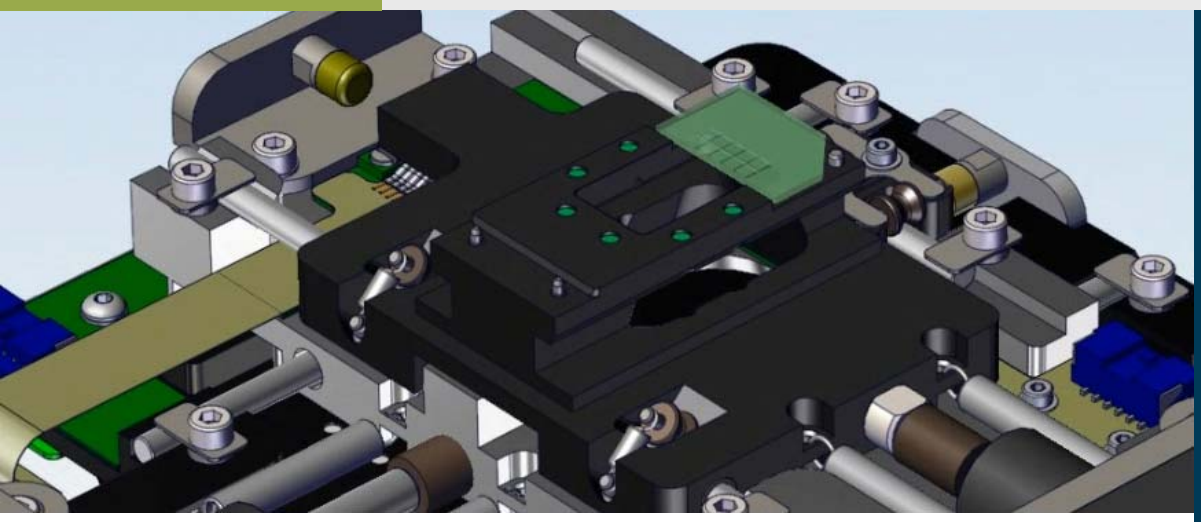
The prototype was made up of static and moving systems. Lathrop performed a Monte Carlo simulation of the design to demonstrate that there would be only a handful of out-of-spec images per million attempts. This real-world way of evaluating tolerances showed that the design would perform very well, which is exactly what the beta testing had demonstrated.

Monte Carlo Simulation

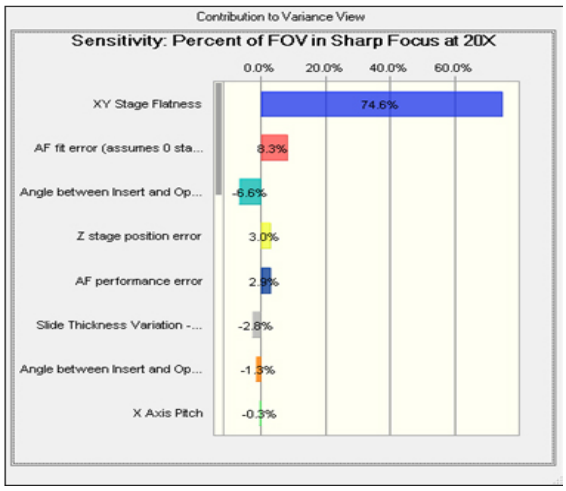
A Monte Carlo simulation works well when one has a complex system with many contributors to performance. No component will be perfect, but the odds of all components being at their extreme limits is very low. A sample of machined parts with tolerances of 0.1mm, for example, will likely have a normal distribution centered about the desired dimension, with a small number of outliers beyond the 0.1mm tolerance. Early in the design phase the shape and sigma level of each tolerance can be estimated based upon the process and upon experience. As prototypes are tested, actual distributions can be substituted for the estimations. A Monte Carlo simulation takes the distributions for each tolerance in the stack and creates tens of thousands of virtual instrument systems or observations, each with a random collection of tolerances based upon the inputs. It then predicts how many of those will meet the system performance requirement. The design can then be modified until the defect level has been minimized to an acceptable level.



Simulation Results: Requirement will be met 99.99% of the time.

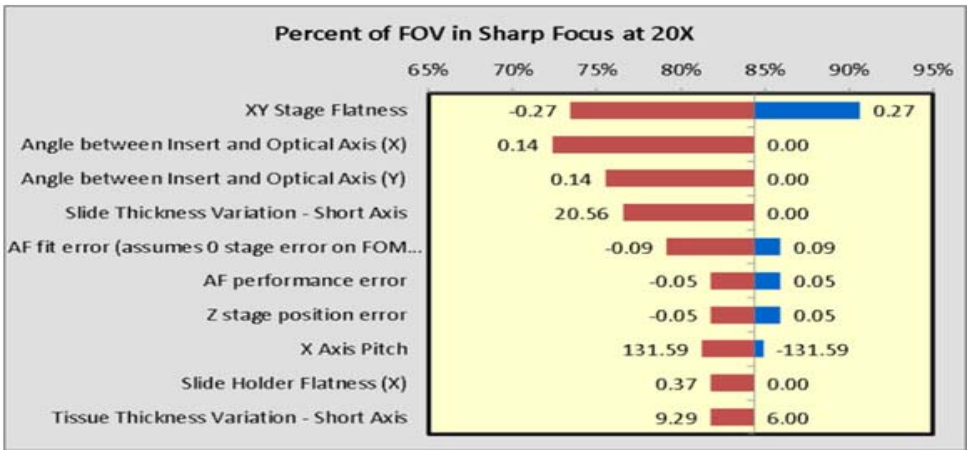


Sensitivity Analysis: Do What Matters Most



Sensitivity Analysis: Amount of variation in result explained by each input

When faced with a complex tolerance stack up it can be difficult to know where to focus design and manufacturing resources. Design improvements cost time and money while tight tolerances create recurring costs. A sensitivity analysis reveals which tolerances have a large impact on performance, and which have little impact. Resources can then be properly focused for the greatest return on investment.



Sensitivity Analysis: Impact of each input parameter on the result

Recent News at Lathrop

1,2,3...Finished!

Recently, a major biotech firm contacted Lathrop with the desire to have an instrument model / communication prototype for an internal management meeting.

The problem ….1) “Only a rough concept for the consumable exists.” 2) “We need it delivered in three weeks.” 3) “We actually need two instruments with working touchscreens, drawer mechanisms and status lights, along with 6 cartridges.”
The gauntlet had been thrown down and the challenge stood before us.

The solution…. 1) lots of collaborative brainstorming and quick decisions in week one. 2) Incredibly quick CAD modeling and order placement in week two. 3) Awesome vendors jumping thru hoops, scavenging parts from client’s current instrument inventory and quick assembly and debug.

The result... 1) one happy customer, 2) two delivered communication prototypes, and 3) one satisfied albeit tired design team.

Lathrop Celebrates 30 years of Success

Lathrop has been providing top notch design and engineering services since its founding in 1982.

Upcoming Events

- **June 16—19, 2012 American Society for Microbiology**
  ASM 2012 - San Francisco CA
  Booth 523

- **July 17-19, 2012 American Association for Clinical Chemistry**
  AACC 2012 - Los Angeles CA
  Booth 2153

- **October 25-27 Association for Molecular Pathology**
  AMP 2012 - Long Beach CA
  Booth TBA

Lathrop exhibits and attends many tradeshows throughout the year across the country. Come visit us at our booth. If you cannot make it to the tradeshow, call us and we can schedule a visit while we are in your area.

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LathropNEWS Preview

Topics of Upcoming Newsletters

Issue 110, 112, & 114 A three part series: Understanding Industrial Design
Issue 111 Risk and Hazards
Issue 113 Gap Analysis

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www.lathropengineering.com twitter @LathropTLH bobl@lathropengineering.com 408.260.2111