

Error Budgets for Optical Systems

This course is designed for those who work with optical systems or are new to engineering.

In addition to size, weight, power, and cost, optical systems also have numerous performance *requirements*, such as magnification, wavefront error, modulation transfer function, distortion, spectral transmission, and more. These requirements must be converted to *specifications* for those working in different disciplines, such as lens design, mechanical design, thermal control, and manufacturing, and those working on different subsystems.

In many cases, the specifications must be shared between disciplines, often in the form of error budgets. The systems engineer plays the role of bridging the gaps between disciplines, managing the system level requirements to ensure customer needs are met.

Three different optical systems are as reference examples in this course. Beginning with a set of system level requirements, we demonstrate methods of *flowing down* this information to subsystems and subdisciplines. We show how results from manufacturing, measurement, and analytical simulation are then used to refine performance predictions. Specifically, we cover focal length, wavefront error, geolocation, spectral transmission, and MTF.

Only very simple math is used, and knowledge of specific software is not required.

The learner will walk away with a broad understanding of how error budgets are used to guide the development of complex optical systems.

Format: The course is 5.5 hours, divided into 8 video modules that can be watched at the learner's own pace.

Cost: \$200 per learner

About the Instructor



Jennifer is an optical engineer who has worked with and around optical systems since 1986. Jennifer specializes in systems engineering, optical system modeling, and manufacturing metrology, and has worked at Eastman Kodak, IMAX, and Optimax Systems. She has also taught Statistics at the State University of New York at Brockport.

Contact

Contact me about setting up a live course at your location

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Video Module Checklist

- Module 1:** Introduction (34 minutes)
 - Systems engineering definition
 - Three sample optical systems
 - System level requirements
 - Considerations for performance
 - When is an error budget warranted?

- Module 2:** Camera Lens Error Budgets (42 minutes)
 - Weight budget
 - Ten steps for error budgeting
 - Focal length budget, steps 1-6

- Module 3:** Camera Lens Focal Length Budget, continued (47 minutes)
 - Step 7: Replace allocations with analytical predictions
 - Step 8: Combine errors based on a statistical plan

- Module 4:** Camera Lens Focal Length Budget, completed (36 minutes)
 - Step 9: Consider calibration, compensation, and correction
 - Step 10: Update budget throughout build, test, and prototyping

- Module 5A:** The Wavefront Error Budget (51 minutes)
 - Wavefront error defined
 - Steps 1-4

- Module 5B:** The Wavefront Error Budget (continued) (28 minutes)
 - Steps 4-10

- Module 6A:** Geolocation, Spectroscopy (33 minutes)
 - Geolocation error budget
 - Spectral transmission budget (Spectroscopy)

- Module 6B:** Spectral Transmission, MTF, and Summary (60 minutes)
 - Spectral Transmission (continued)
 - MTF
 - Summary