Boulder Optical Design

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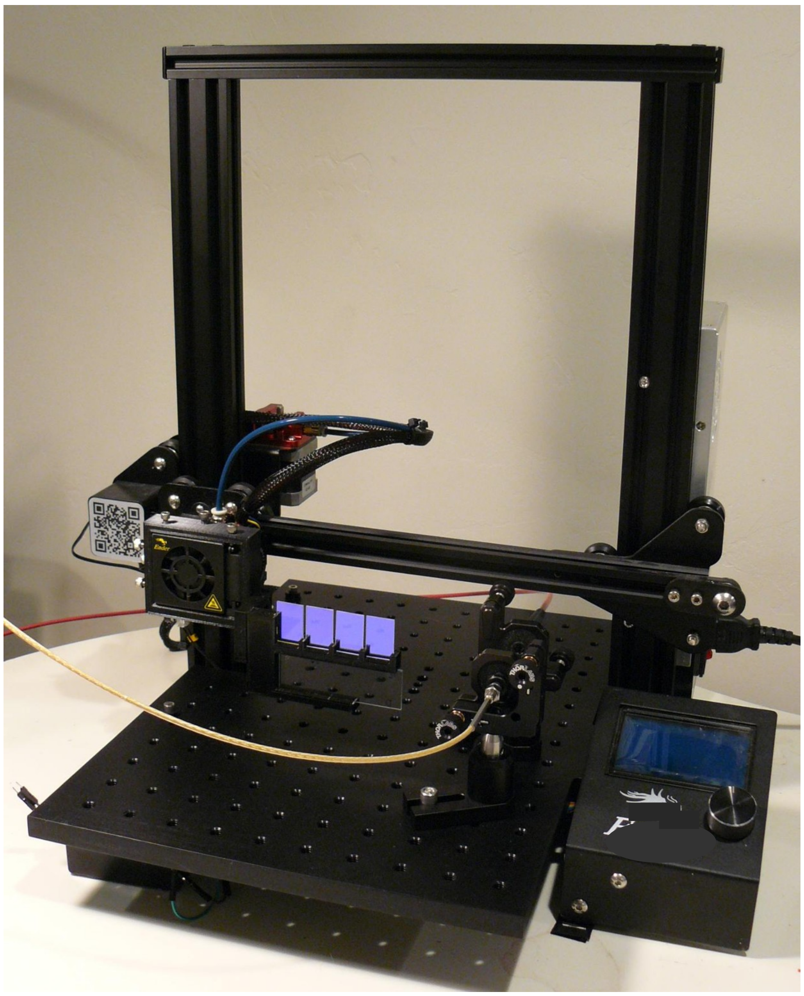
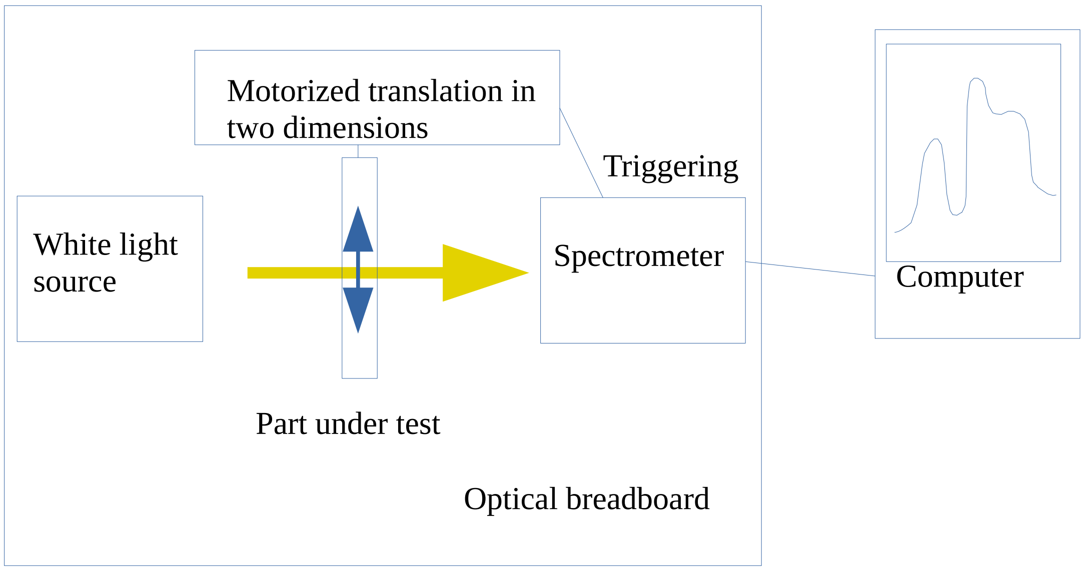
Measurement system for spatial thin film measurements



This is a general system for measuring optical properties as a function of spatial position on a part. It can accommodate a wide range of optical measurements, although it is especially suited for measuring the spatial variation of transmittance and reflectance spectra. A sketch of the system is shown below for a simple transmittance measurement.



We can sell this very fancy system for an amazingly low price, because the motion stage is based on a low-cost 3d printer that is produced at great economy of scale.

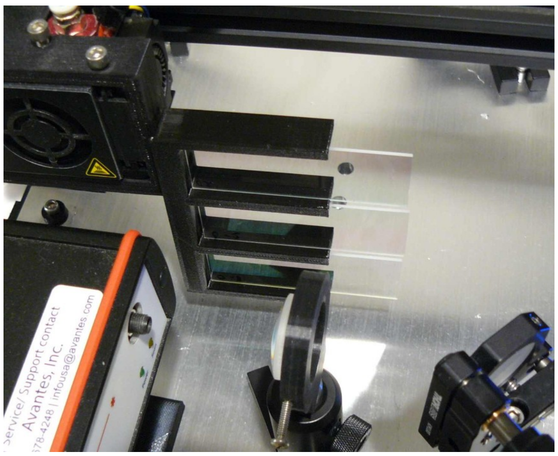
System description:

In the photo, the system has a very basic optical setup, which is not part of the basic system. A simple setup like this can provide spatial resolution of about 0.5 mm, and more complex optical setups can further improve the spatial resolution.

The build plate is a fairly large optical bread board (about 16" by 12"), of stiff half-inch thick aluminum with standard 1/4-40 tapped holes on a 1 inch grid pattern. The gantry-style motion stage is from a 3d printer, where one degree of motion has been disabled to allow for the large optical breadboard. (If 3-d motion is needed, we could accommodate that, probably with some trade-off of stiffness.)

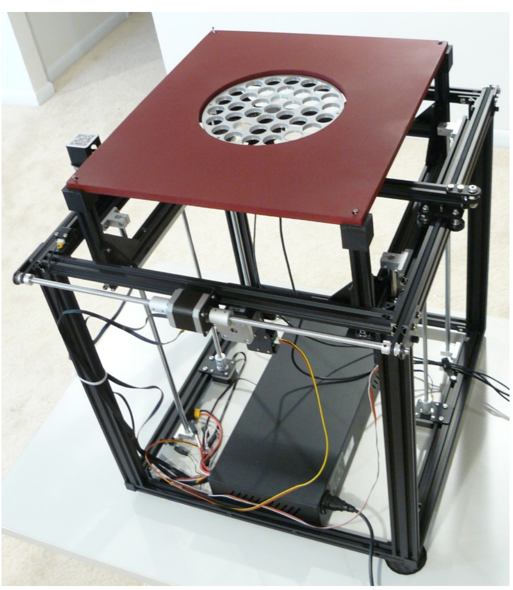
The system is great for uniformity testing, batch testing of parts, or a measurements of spatially-varying thin films.

The part holder shown in the photo is for a demonstration, holding a glass slide on the bottom and several smaller parts on the top. Part holders are easily changed out, and I recommend 3d- printing them with material PLA. With the basic system, part holders for holding glass slides and 1 inch diameter parts. We are happy to accommodate special requests. The part holder shown below holds several microscope slides. This is useful for uniformity measurements and for beam profile mapping.



Large part and whole planet variation

This variation uses a much larger stage, that we normally use for our automated inspection system. An image is shown below.



Reflection measurement fixture

This variation is primarily for reflection measurements. The image on the left shows how a whole planet is dropped right in, so no extra tooling is necessary for testing of coated optics. The image on the right shows the reflection fixture, which measures the reflection of the bottom surface.

Reflection measurements require more precision in the tooling. Fortunately, typical planetary tooling for thin film coating does meet the need for high precision. For the highest precision a transmission measurement is usually better, but in many cases the benefits make this a better solution in production. These benefits include: (1) dropping the whole planet right into into the system, without double-handling of the parts; (2) This variation can handle parts that are large and heavy; (3) The position and orientation of all the parts in the planet are maintained automatically.

The software is the same for the normal system and for this variation, the software is described next.

Software:

For maximum flexibility, software is packaged into several stand-alone in pieces. One script converts a grid or list of positions into g-code, also adding in the delay and triggering calls for the measurement.

The main code then runs on a PC with the g-code running concurrently on the stage. The stage triggers the spectrometer, which issue a callback to the main code for saving the spectrum. This main program is currently written for Avantes spectrometers.

The software can also be used without the stage system at all. First it can be used in a simple “push-N-measure” mode, where the user moves to each point and pushes a button to trigger the spectrometer. Then the spectra are saved in exactly the same way, via the spectrometer callback function. Another mode is to slide the part along a simple rail, and the spectrometer is triggered by tabs moving through a sensor, in exactly the same way as our typical optical monitors.

Analysis of the spectra is more specialized for different applications. We are happy to help you with analysis software for your special applications, but we also encourage users to write their own scripts to analyze the spectra and display results. We do provide an Octave (Matlab) script to analyze standard uniformity measurements, and this can also serve as a template for developing more complex analysis scripts. Typical accuracy of uniformity measurements is to within 0.1% or better.

System specifications:

- Motorized stage, 2 dimensional motion.
- Position repeatability: Better than 0.1 mm (100 micron).
- Position movement speed: About 50 mm/s horizontal, 10 mm/s vertical.
- Motion range 220 x 220 mm. For the whole planet variation, 350 x 350 mm.
- Typical rate of measurements: About two measurements per second for step and measure, and about 5 measurements per second in a continuous sweep without stopping.
- Optical build plate dimensions: About 16" by 12" (There is some unusable space.) Thickness 0.5" (12.7 mm).
- Trigger signal from system to spectrometer: TTL or can be set to different levels.
- Control motion, spectrometer triggering, and auto-homing with g-code commands.

The basic system is sold without optical elements, but we can also quote on setting up optical systems for specific measurements.

More information: Please feel free to call for pricing and delivery information, or to discuss how the system can work for you.

(Please excuse the anti-spam image format showing the email.)

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