University Research Team Faces Challenges of Measuring Multiple Lasers

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The scientific community is often faced with the requirement of testing, validating, or merely qualifying several laser sources planned for a particular project. Such testing is needed to:

- Ensure the laser source is performing up to the manufacturer’s specification
- Diagnose the quality and measurement aspect of the resulting beam
- Establish a baseline of the laser’s performance to be used against future measurements to determine if the laser has degraded or otherwise shifted in its performance.

This task puts a financial burden on the lab. They need to use commercially available tools in the most efficient manner possible, and get them funded through the same program under which the laser sources were acquired. Unfortunately, when it becomes known that this type of laser performance information is needed, the laser systems are typically already in place, the experiments are ready to be conducted, and any delays could be counterproductive to the guidelines of the grant. Therefore laser measurement equipment must be found that is cost effective, commercially available, easy to use, quick to set up, and informative to the level of full acceptance to scientific staff, as well as to the community reviewing the grant results.

In this application, the University had acquired three (3) different lasers, all low power, i.e., <5mW. The challenge arose in that the wavelength of the laser sources spanned a large range. The first laser was a 700nm source with about a 3mm diameter beam. The second was a 1300nm source with a beam diameter about 3mm. The last laser was a 1800nm source with a beam diameter of 0.8mm.

The initial selection of beam diagnostic equipment by the researcher resulted in a very expensive approach, quite sufficient but expensive. The equipment involved the choice of two beam profile cameras, one for use on the 700nm source and a
second for use on the 1300nm and 1800nm sources. As is often the case in university research, the budgets was tight, especially after most of the funding had been exhausted on the procurement of the lasers. That meant little was left over for diagnostic test equipment.

The solution was the Ophir-Spiricon XC-130 InGaAs beam profiling camera (30um x 30um pixels, 320 x 256 array, 9.6mm x 7.6mm size). This camera could be used for all three laser applications, delivering easy of use, accurate results, and a common set of equipment. This particular diagnostic camera was selected based on a physical laboratory test of all three sources. Although the baseline specification for the Spiricon XC130 reports absorption sensitivity of the array from 900nm to 1700nm, previous testing had shown that with sufficient power, the camera array can image below 900nm, down to possibly 700nm, and upwards to 1800nm. However, the specification was firm and no guarantees were offered so testing was mandatory.

**Testing 700nm Laser**
The first test was conducted on the 700nm source, with power measured at 281uW average power. The sensitivity of the XC130, using a feature of the software that allows the summing of 11 camera frames, provided sufficient imaging capability to view the beam and obtain accurate measurements. Although the camera is not specified for a shorter wavelength of 700nm and 281uW, the camera can be used to shorter wavelengths (no guarantees by the manufacturer) and enhanced using the beam diagnostic software.
Testing 1300nm Laser
The second source then needed to be tested. This one was set for 1300nm with a 2-3mm beam diameter and an average power of 3mW. A standard visible CCD profiling camera can be pushed to this limit under rare circumstances, typically by over-driving the power of the source into the camera.

This source was also tested using the Spiricon XC130 camera and, as expected, the beam was easily imaged and profiled as this wavelength is right in the middle of the camera’s specified array absorption range. These results were expected.

Testing 1800nm Laser
The last laser source would be a challenge as the wavelength was reported to be 687uW average power at 1800nm, just beyond the manufacturer’s specification of 1700nm for this particular camera. It was expected that the test would prove inconclusive, at best.

The laser and camera were fixtureed and then tested. The test proved that for this application, considering wavelength and power, a sufficient image and graphic measurement was possible and better than expected in spite of the manufacturer’s specification.
Through the testing and validation of the beam diagnostic camera and software, the researcher was able to source one camera rather than two to cover all three laser applications. Testing the camera on each of the sources to prove it was possible to graphically image and measure each source was critical to the justification of the equipment. In this case, the researcher chose to push the limits of the equipment to determine if, in his applications, this one solution made sense. In this case it did. It is likely these results are not typical or likely if the specification for the equipment followed to the letter. The researcher was able to prove that one camera, if pushed, can be used to solve an otherwise expensive problem.