

Towards Calibrated, Traceable Measurements of the Melt Pool on the NIST Additive Manufacturing Metrology Testbed

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The Additive Manufacturing Metrology Testbed (AMMT) is a fully customized research platform developed by National Institute of Standards and Technology (NIST) to study physical phenomena, process optimization, and process monitoring and control of the laser powder bed fusion (LPBF) process. One of the primary goals of the AMMT is to enable well-characterized and traceable measurements, most notably of the true surface temperature field in and around the laser-induced melt pool, to provide exemplar reference data for tuning or validation of AM process simulations. This talk will detail the design and layout of the AMMT, with focus on the optical system design and in-situ calibration sources that are the core of establishing traceable melt pool temperature measurements. The multi-step calibration and measurement method for radiance temperature, surface emittance, and true temperature are then detailed, along with a preview of some of components of measurement uncertainty that are applicable to other imaging-based melt pool measurements. Finally, some example temperature measurements are provided on high purity metals and metal alloys, as well as preview of results of other unique melt pool measurement techniques developed on the AMMT.