

Nuclear Engineering Seminar

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Pulsed Thermal Tomography Nondestructive Evaluation of Additively Manufactured Reactor Structural Materials

Abstract

Recent advances in additive manufacturing (AM) of metals could allow for cost-efficient fabrication of replacement parts in operating reactors, as well as reduction of construction costs in future reactors. However, because of stringent safety requirements, long-term performance of AM reactor components needs to be investigated before AM is widely accepted. Commonly encountered material flaws in AM of metallic parts include regions of low density, such as porosity introduced into AM parts due to incomplete melting of the powder particles or insufficient overlapping of the melt pools. Pulsed thermal tomography (PTT) is well suited for nondestructive evaluation (NDE) of AM metallic components because the method is non-contact and one-sided, and offers high resolution 3-D imaging of material flaws. PTT obtains reconstruction of material internal defects by monitoring surface temperature transients with an infrared camera following thermal pulse from a flash lamp applied to material surface. Current research activities include development of performance metrics for PTT detection of flaw size and flaw location relative to material surface. The results obtained thus far indicate that PTT can image flaws 1mm in size, which is the smallest calibrated flaw created in metallic specimens. PTT was capable of imaging through the entire plate.

Alexander Heifetz is currently a Principal Electrical Engineer with Nuclear Science and Engineering (NSE) Division at Argonne National Laboratory (ANL). He received PhD in Electrical Engineering from Northwestern University. He first joined ANL as Director's Postdoctoral Fellow with NSE, and later became technical staff member. He has published over 50 journal papers (with 1000+ citations), and has 3 US Patents. His work at ANL has been sponsored by and DOE Nuclear Energy Enabling Technology (NEET) Advanced Methods in Manufacturing (AMM) and Advanced Sensors and Instrumentation (ASI) programs, as well as NNSA/NA-22.