Announcing the Final Examination of Jonathan Torres-Caceres for the degree of Doctor of Philosophy

Time & Location: April 2, 2018 at 9:00 AM in ENG 2 312
Title: A FRAMEWORK FOR MINIATURIZED MECHANICAL CHARACTERIZATION OF TENSILE, CREEP, AND FATIGUE PROPERTIES OF SLM ALLOYS

With the heightened design complexity that may be achieved through additive manufacturing (AM) comes an equally complex set of distinct material characteristics. To properly characterize new materials for use in selective laser melting (SLM), extensive analysis is necessary. Traditional testing techniques, however, can be prohibitive in time and cost incurred. The small punch test (SPT) has been developed for such purposes, where material is scarce or costly. Although lacking standardization, SPT has been successfully employed with various materials to assess material properties such as the yield and ultimate strength and verified by traditional testing results. With the accompaniment of numerical simulations for use in the inverse method and determining correlation factors, several methods exist for equating SPT results with traditional results. There are, however, areas of weakness with SPT which require development, and the solution of the inverse method can be demanding of time and resources. Additionally, the combination of SPT and SLM is relatively unexplored in literature, though studies have shown that SPT is sensitive to the types of structures and unique material characteristics present in SLM components. The present research therefore focuses on developing a framework for characterizing SLM materials via the small punch test. Several types of SLM materials in various orientations and processing states are small punch tested to evaluate the ability of the SPT to track the effects of these as they cause the materials to evolve. A novel cyclic test method is proposed to fill the gap in SPT fatigue testing. Results from these tests are evaluated via numerical modelling using the inverse method solved with the least squares method. Samples were also inspected using digital microscopy to connect fracture morphology to processing parameter variations. A framework is thus presented with which SPT may be utilized to more economically and expeditiously characterize SLM materials.

Major: Mechanical Engineering

Educational Career:
Bachelor's of Mechanical Engineering, BS, 2011, University of Central Florida
Master's of Mechanical Engineering, MS, 2013, University of Central Florida

Committee in Charge:
Ali P. Gordon, Chair, Mechanical & Aerospace Engineering
Jayanta Kapat, Mechanical & Aerospace Engineering
Seetha Raghavan, Mechanical & Aerospace Engineering
Martin Richardson, Optics

Approved for distribution by Ali P. Gordon, Committee Chair, on March 20, 2018.

The public is welcome to attend.