I/UCRC Executive Summary - Project Synopsis		**Date**: 9-September 2018
Center/Site: CANFSA/Iowa State University		
Tracking No.: 35: Understanding Texture Development in Linear Friction Welded Ti-6Al-4V	**Phone :** (515) 294 - 5127	**E-mail : pcollins@iastate.edu**
Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke		**Type: Continuing**
Project Leader: Peter Collins		**Proposed Budget**: $ 60,000

Project Description: Linear Friction Welding (LFW) is a solid phase bonding process, which is particularly appropriate for titanium alloys. Due to the titanium's great affinity for oxygen, nitrogen and hydrogen, protective atmospheres must be used to not contaminate the welded material. LFW avoids the formation of a liquid phase during the welding process, and can therefore be carried out in air. The typical defects caused by melting and solidification during traditional welding process such as pores, pinholes, shrinkage cracks and grain coarsening are therefore avoided. However, due to the LFW process, a narrow and extensively deformed region forms adjacent to the bond line. *This region has significant variations in microstructure that can influence performance of components.* Understanding the variations in microstructure in this region is far from mature. In addition, high frequency oscillation during the weld can result in textured structures along the bond line. *The influence of these textured regions on cold dwell fatigue have not been explored.*

Experimental plan: The proposed project will focus on understanding microstructural evolution during LFW and explore the effect of these structures on mechanical properties, including cold dwell fatigue. The effect of any texture zones on mechanical properties, especially cold dwell fatigue, will also be explored.

Related work elsewhere: Very little work has been conducted to understand the formation of texture and its influence on properties and performance.

How this project is different: This project seeks to provide quantified microstructural information and preliminary assessments of strength and fatigue behavior.

Milestones for the current proposed year: Characterization of the microstructure and texture of LFW materials. Preliminary estimations of yield strength and proposed methods to test the fatigue behavior are underway.

Deliverables for the current proposed year: Characterized material. Properties. Literature review.

How the project may be transformative and/or benefit society: Titanium alloys are widely used in aerospace applications for their high strength to weight ratio, good corrosion resistance and metallurgical stability. In recent years, the drive towards reduction in energy consumption has put emphasis on the use of lighter weight materials. And, more titanium hardware is being used in aerospace applications. At the same time, cost reduction and conservation of resources have driven towards more cost-effective production methods requiring less machining and less material waste. New joining methods are being implemented that allow for a more near-net component shape, reducing the amount of post machining required.

Research areas of expertise needed for project success: Microstructural characterization. Understanding of composition-microstructure-property relationships. Ability to analyze texture. Fatigue.

Potential Member Company Benefits: Understanding of new joining processes.

Progress to Date: Preliminary microstructural investigation. Preliminary design of testing geometries to assess properties.

Estimated Start Date: Spring 2018	**Estimated Knowledge Transfer Date**: Spring 2019