LIGHTWEIGHT INNOVATIONS

Technology Project Abstract:

Agile R2-4: Sustainable High Efficiency Machining

Lead Industry Partner: UTRC

Lead Research Partners:

Technology Pillar: Novel-Agile Processing

Project Summary

This project will develop and demonstrate advanced sustainable, high-efficiency machining technologies to achieve at least a 3x material removal rate improvement for machining lightweight materials using a systems engineering approach to integrate key machining technology to components including: cryogenic and ultrasonic machining; process dynamics modeling; and physics-based machining process optimization.

Technology Gap / Need

The project will improve material removal rate for machining lightweight materials, such as titanium and aluminum. It will adopt mature technology components related to cryogenic and ultrasonic machining necessary to achieve an improved rate. It will also develop and apply physics-based models and monitoring to optimize processing and predict effects of state-of-the-art machining processes.

Focus/Technology

The key focus areas of this project are:

Cryogenic Machining: Key to achieving high-speed machining of metals is controlling the temperature to allow efficient and effective heat transfer away from the workpiece without affecting the tool.

Ultrasonic Machining: Utilizing high-frequency vibration, ultrasonic machining significantly alters the frictional tool-chip force components imparting lower operational forces, improving tool life, and enabling increased feed rates.

Machining Process Dynamics: Machining process dynamic models are well developed and commercial tools based on these dynamic models are available to control dynamics such as chatter and vibration.

Model-based Machining Process Monitoring: Process health monitoring is critical to insuring the machining process runs smoothly without issue. Physics based machining models will establish these limits considering normal process parameter variations.

Project Benefits

Sustainable high efficiency machining technologies will significantly increase productivity, increase process capacity, reduce machining cost, improve part quality and reduce scraps and waste related to the processing of hard to machine lightweight metals. Enabling 3x or more material removal rate improvement through cryogenic or ultrasonic machining will significantly reduce machining cycle time and increase productivity of the industrial base. This will increase the capacity of the current production lines, and avoid the need for new capital equipment.

Education & Workforce Impact

The project will develop the future workforce by engaging senior undergraduate and graduate students at both the University of Kentucky and University of Michigan, and providing education materials on this advanced machining technology to the general public.

Project Duration

Start: January 2017

End: November 2018

Funding

Total Project Value: $2.5M

Participants

Industry Partners	Research Partners
UTRC	University of Kentucky
Lockheed Martin	University of Michigan
GKN	EWI
DNV GL	