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Archive - Potential NGI Applications

Characterization, Remote Access, and Simulation of Hexapod Machines:
Sponsored by National Institute of Standards and Technology (NIST)

Categories:

Manufacturing, Remote Operations, Collaboration

Vision

To provide remote operation, data collection, and simulation of a new class of parallel-actuated machine tools as the basic low-level operations of a collaboratory in the area of machine tool research.

Why NGI?

The collaboratory will require the bi-directional exchange of full motion video, audio, data collection, sharing of simulation results, and remote use of a large machine tool. The lower levels of motion control require minimum latency and a deterministic timing response while the video and data streams will require at least 80 megabits/sec. Current Internet technology can not provide either over a wide area network in a cost-effective manner.

Description

Hexapod machines are a new class of parallel-actuated machine tools based on the Stewart platform mechanism that present new possibilities for high-speed, high-accuracy, high-stiffness, multiaxis machining. Much remains to be learned about the characteristics of these Hexapod machines before they will see widespread production application. The goals of this project are to develop methods to characterize and extend the limits of performance of hexapods in terms of accuracy, productivity, and versatility through the development and implementation of virtual and distributed manufacturing technologies.

There are three major areas of interest: 1) characterization of Hexapods to better understand their behavior, 2) remote interaction to provide real-time audio, video, and sensor data to researchers at remote sites, and 3) simulation of Hexapods to validate machine motions and investigate errors characteristics and structural dynamics. The demonstration will focus on 2) and 3) to aid remote researchers in determining part machinability and location within the Hexapod's work volume. A typical scenario will entail the use of interactive simulation to determine part placement followed by "over the shoulder" operation of the machine by the remote user. The remote user will receive real-time data (e.g. position, tool chatter) and will interact with the onsite machine operator in running the machining experiments to aid in the determination of feeds and speeds.

Rationale

Rapid production of quality contoured parts requires machine tools that combine speed, accuracy, stiffness, and multiaxis versatility. In addition, manufacturers look for qualities, such as ease of installation and movability, to enable plants to be reconfigured to meet changing market demands. A new class of parallel-actuated machine tools based on the Stewart platform mechanism presents new possibilities to meet these needs. It also presents acceptance difficulties in a conservative industry. Industry workshops have highlighted, among other things, modeling and simulation tools for developing applications and test methods and remote access capabilities to make it easier for external collaborators to interact and participate in the work being done.

Requirements

The Hexapod will require the challenging mix of bi-directional full-motion video and audio of the machine (50 Mbps), coupled with uni-directional data collection and machine control information. The "over the shoulder" operation of the machine is required to be low latency and deterministic in nature, but is otherwise low bandwidth (2 Mbps, 50 msec latency). The data collection shares the requirements of low latency and deterministic operation, but at higher bandwidth (5 Mbps). The collaboration portions can have greater latency, but requires the same high bandwidth (20 Mbps) as other collaboratories being proposed.

Partners and Potential Partners

National Institute of Standards and Technology (Gaithersburg, MD)
Sandia National Labs (Albuquerque, NM)
Sandia National Labs (Livermore, CA)
United Technologies Research Corp. (East Hartford, CT) (potential)
Ingersoll Milling Machine (Rockford, IL) (potential)

URLs

http://www.nist.gov/mel/namt