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ON LINE TOOL WEAR MONITORING AND ADAPTATION FOR ENHANCED TOOL LIFE IN TURNING PROCESSES

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Cutting tool wear is a normal phenomenon occurring in any metal cutting process which normally affects the contact conditions at the tool-work interface. The process of tool wear will reduce the work quality and effective machine utilization (due to frequent tool regrinding / insert change) while increasing the power consumption, which ultimately increase the production cost. Therefore it is very essential to have an effective on-line tool management system attached to the machine, instead of relying on the subjective judgment of a machinist as to whether or not a tool has reached its wear limit. In addition to this, such a system could also be required to optimize the cutting conditions to enhance the tool life instead of employing conservative feeds and speeds. As a basis for the construction of such a system, we have started a study on turning processes with two objectives.

1. Establishment of a tool change policy :- The tool wear is proposed to be tracked continuously using indirect methods, sensing tool vibration, acoustic emission and dimensional variation of the component in order to establish a tool change policy.
2. Enhancement of tool life :- Development of an adaptive control technique to adjust the machining conditions such as cutting speed, feed and depth of cut in order to enhance the tool life.

This paper presents the feasibility study we have conducted to detect the tool wear in order to establish a tool change policy. Experiments were conducted with cast iron (short chips) and bright steel (long chip) work materials using Sandvik TNMA and TNMG tungsten carbide inserts respectively, on T-MAX P lever tool holder, under different cutting conditions such as speed and feed. The acoustic signals emitted during the turning processes were recorded every fifteen minutes on a PC with 12 bits A/D converter, built into RTI 800/815 multifunction input/output board using ECM-50PSW condenser microphone along with a control power amplifier. Simultaneously the actual tool wear (flank and carter wear) too was measured using shadow projector and recorded for comparison. The acoustic signals thus obtained were processed off line and found to have an excellent on-line tool wear detection capability.

Experiments will be carried out in order to monitor the cutting tool vibration too in determining the validity of such information, for detecting the tool wear. It is planned to devise pneumatic on-line measurement system for detecting the dimensional variation resulting from tool flank wear. The present task is to use the information extracted through these sensors in computing an Autoregressive model representing the cutting process and decision making (tool changing policy) will be based on the calculated model parameters at frequent time intervals.