Application of acoustic emission sensor to investigate the frequency of tool wear and plastic deformation in tool condition monitoring

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Highlights
• The process of tool wear in turning has been replicated by material removal in grinding.
• The AE signal frequency of tool wear has separated from plastic deformation frequency.
• The amplitude of AE signal increases with the increase of tool wear.
• The frequency of AE signal increases with the increase of material removal.

Abstract
The metal cutting process initiates with the occurrence of plastic deformation of workmaterial and is followed by tear and removal of material from the workpiece. This process ultimately damages cutting tool and causes tool wear. An acoustic emission (AE) sensor has been employed to measure the signal frequency in machining. The AE signal component of tool wear and plastic deformation in turning are separated by simulating the process of tool wear by a grinding test where the workpiece of grinding test is the same tool-insert for turning test, and the process of tool wear in turning is replicated by the process of material removal in grinding. The frequency of tool wear for this particular investigation is found to lie between 67 kHz and 471 kHz whereas for plastic deformation of workmaterial, it has a fluctuation within the range starting from 51 kHz to some value within 471 kHz.

Keywords
Tool condition monitoring; Tool wear; Plastic deformation; Acoustic emission; Signal frequency

1. Introduction
Tool condition monitoring (TCM) denotes a process that persist to keep the cutting tool under surveillance during machining. To ensure an effective TCM, entire occurrences involved in machining should be investigated. Plastic deformation of workmaterial, crack propagation, progressive tool wear, tool fracture, tool breakage, chip formation, chip breakage, chip removal, tool tangling, process interruption, etc. All are dedicatedly involved with the process of metal cutting. The conventional metal cutting and removal