Proposal for Master's thesis in Applied Mechanics

Wave propagation in human tissue from transient high frequency vibrations

Injuries to the human hand caused by vibrating hand held machines are one of the largest workplace problems today. In Sweden, more than 350 000 workers are exposed more than two hours a day to vibrations from vibrating tools.

The current standard for risk evaluation takes no account of vibrations with a frequency content above 1250 Hz. This implies that the vibration from tools with a striking impact approach such as impact wrenches are greatly underestimated because the vibrations primary energy content is far above 1 kHz. The transients have often an acceleration level exceeding 10 000 m/s2.

The project aims to study how and to what extent transient high frequency vibrations propagate in human tissue. In the first place a finger. The results can then be used as a basis in the formulation of standards governing exposure to vibration to people and for preventive measures.

Problem Description: The goal is to develop a FEM model to study how the high frequency vibrations propagate in a finger and how it is affected by different parameters in the skin. It is expected to use experimental data for parameter identification problem and model validation.

Implementation: The work involves studies of literature to find appropriate material data for the parts of the finger. Some of the literature to examine will be wave propagation for neighboring areas such as ultrasound diagnostics, ultrasound cleaning and its related hazarders. Particular emphasis will be placed on modeling the skin and the fingerprint. By using appropriate FEM and tools developing of wave propagation model for analysis of the penetration of vibrations into the soft tissues in a finger. Experimental validation will be made by accelerometers and pressure transducers but needs to be determined closer during the project.

Work will be performed at Chalmers and RISE Research Institutes of Sweden-RISE IVF AB in Mölndal. Students' work will be financially compensated in accordance with RISE IVF AB policy.

Student background: This project is suitable for (preferably two) students with an interest in computational mechanics, experimental verification and biomechanics related areas.

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