Dynamic structural analysis of a Hybrid CNC metal 3D printing & milling machine

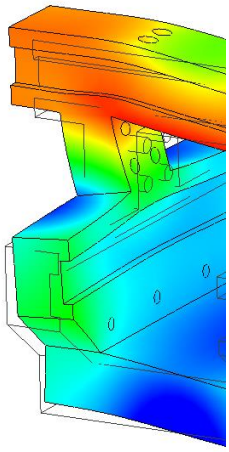
Master thesis proposal 2019-2020, AVRG, MECH VUB

3D printing of metal components brings a very large design freedom into the production of metallic parts. When combined with traditional subtractive (milling, turning) techniques a high-performance hybrid machining platform allows to manufacture metallic parts with large design freedom, but also with functional features (geometric tolerances) and good surface finishes.

The AVRG research group from the Mechanical Engineering department at the Vrije Universiteit Brussel is involved for over 5 years in the monitoring and control of the melt pool of Direct Laser Metal Deposition (LMD) 3D printing of metal components. Since 2017 the group has been designing and building their own Hybrid laser metal 3D printing machine, combining LMD additive & High-speed milling techniques into one machine platform: MiCLAD. A 6 ton heavy 2 x 2 meter combined metal 3D printer & milling machine.

The aim of this thesis is to perform an experimental/numerical study and analysis of the dynamic behaviour of this in-house developed machining platform. The interaction of the machine frame stiffness and mass on the one hand, and the motion components such as bearings and linear motors on the other hand are to be quantified or simulated.

For this study the student will use either experimental modal analysis instruments & software (LMS Test Lab, existing in-house developed Matlab code, …), or Finite Element Analysis (ABAQUS) & mechatronic simulation software (Simulink).



The student should have a general interest in dynamics of structures. Although the work is practical, the student will get in contact with some statistical and mathematical theories of signal processing & system identification. Topics such as optimization, parameter identification and nonlinearities will have to be tackled in an applied manner.

Based on the interest of the student, experimental, numerical or combined analysis of the machine tool structure is possible. The outcome of this thesis will contribute to the optimisation of the control parameters of the position control of the Hybrid CNC 3D printing & milling machine MiCLAD, build at the VUB.

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