IMT Lille Douai
École Mines-Télécom
IMT-Université de Lille

Online monitoring and Quality Optimization of 3D Printing Machines by AI and DataAnalytics

A postdoc position is offered at IMT Lille Douai, Digital Systems Center, as a part of INTERREG North-West Europe CIRMAP project,
Duration: 18 months of contract,
Starting Date: March 2021

We are looking for a candidate with a scientific background on Systems engineering and Automatic control and a PhD in one of the following fields: control theory, system identification, process modelling or Robotics. Knowledge of 3D printing solutions or industrial axis robots is a plus.

Context and motivation

The CIRMAP project aims at developing new solutions for the design and manufacture of urban furniture by 3DP with ecological materials. The project will address North of France, Belgium, West of Germany, Netherlands, United Kingdom and all the North West Europe where similar typologies of recycled/substitution materials can be found. Design and optimization of shapes will allow a reduction of mortar's quantity. Use of local recycled sand will allow avoiding natural resource depletion and landfilling. Substituting natural constituents by recycled ones could reduce the regularity of the printed material and then lead to the use of an online monitoring and control during printing in order to track and to compensate properties variability. Moreover, the durability of mortars could be affected by the use of recycled materials. Hence, 3D printing process parameters have also to be optimized with regard to these aspects, using data-driven strategy and physics knowledge.

Contribution and work to be achieved during this post-doc

- State of art :

The candidate will study and implement an innovative methodology for optimizing the quality of a new 3D printing machine. Therefore, the first task will consist in achieving a survey related to quality control issues in the context of 3D-printing machines, using an increasing amount of recycled material. Strategies for 3D printing process improvement and optimization also will be investigated through an accurate review of scientific papers.

- Process modelling :

The second task consists in contributing to the achievement of a simulation model of the 3D printer (Simulink). This framework will support investigations for on-line monitoring and control strategy designs. The simulation model and its first experiments will help to have a better understanding on the 3D printing machine principles and on the variable and parameter influence using Data Analytics.

- On-line monitoring :

The third task will be to design an on-line monitoring device based on real-time measurements on mortars, printing machine and products. Predictive analysis using Machine Learning and AI will provide efficient indicators to monitor the quality and to track possible drifts. This task will also need to define

an efficient way to control an automated measurement system (2 axis robot) for stiffness evolution of fresh 3DP mortars.

- Control Command

The last task consists in the set-up of a full automated system connected to 3D printer hardware, measurement systems, quality control solution and Master control command. This task aims to define procedures for adaptation of control parameters and set points of the 3D printing robot for a better efficiency and a better quality. Adaptive control laws will be derived from hybridisation between process physical knowledge and SLPV system identification. Algorithms will be inspired by adaptive control for high-precision motion and non-linear control with input delay compensation.

The experiments will be done on an existing solution located in IMT Lille Douai, Douai location. This solution consists of 3 axis printer (stationary) & 2 axis robot for lab testing.
The implementation of a complete solution (Communication Interface with 3D printer robot, On-line measurement system, Quality monitoring, Master control command) will be shared by a team composed or researchers and engineers.

Profile

The candidate must hold a PhD Thesis in Machine learning, Automatic Control or Robotics. The candidate must demonstrate scientific expertise and abilities to implement solutions in one or more areas of : process modelling and estimation, data-driven control and diagnostics,

Contact

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