

# Modeling of Rubber Extrusion process - CFD simulation

Μοντελοποίηση διεργασίας διέλασης ελαστομερών

## Motivation of the Thesis

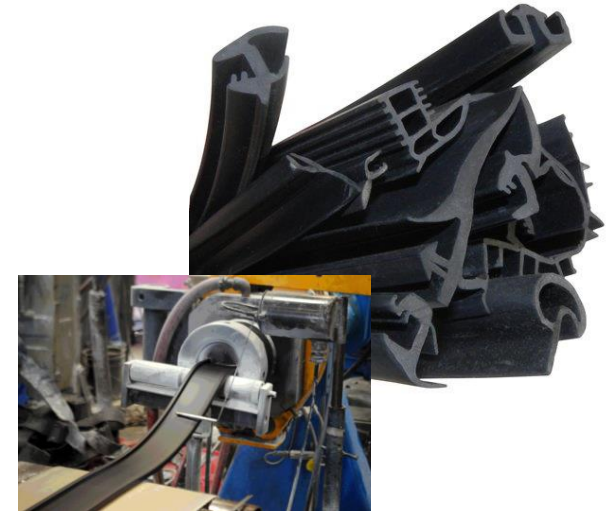
- Near Zero defect manufacturing indicates the use of models for prediction of defects.
- Extrusion of rubber is often accompanied by defects, due to material imperfections and process stochastic phenomena

## Objectives

- Modelling rubber extrusion related phenomena
- Integration of stochastic phenomena
- Prediction of defects

## Outcome / Results

- Simulation results
- Correlation of phenomena with defects



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# Algorithm Design and Development for data processing, transformation and noise removal for near zero defect manufacturing

Σχεδιασμός και ανάπτυξη αλγόριθμου επεξεργασίας και μετασχηματισμού δεδομένων και αφαίρεσης θορύβου κατά την παραγωγή προϊόντων χωρίς σφάλματα

## Motivation of the Thesis

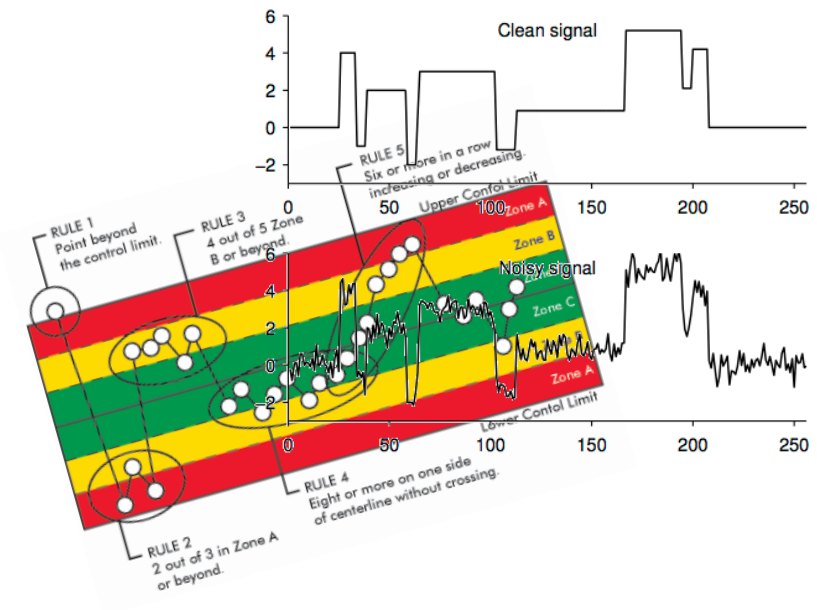
- Near Zero defect manufacturing requires the use of algorithms to filter real time production data from machine level.

## Objectives

- Modelling processes through data
- De-noising of data
- Extraction of information regarding near zero defect manufacturing

## Outcome / Results

- Transformed data
- Knowledge extraction from data



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# Design of an online platform for the visualization of MFG process Data

Σχεδιασμός πλατφόρμας για αποκρίνιση δεδομένων μηχανουργικών διεργασιών

## Motivation of the Thesis

- Near Zero defect manufacturing could benefit from an online platform that would help visualize the Real Time data.
- Designing such a system would require an intuitive and elaborated presentation of data batches.

## Objectives

- Visualization of data
- Help the user pick an appropriate model for correlation of data

## Outcome / Results

- Online platform design



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# Fusion of models with real time data for decision support in near zero defect manufacturing

Συγχώνευση μοντέλων και δεδομένων πραγματικού χρόνου για υποστήριξη λήψης αποφάσεων κατά την παραγωγή προϊόντων χωρίς σφάλματα

## Motivation of the Thesis

- Near Zero defect manufacturing techniques could be able to use both Real time data as diagnostics and models as prognostics.

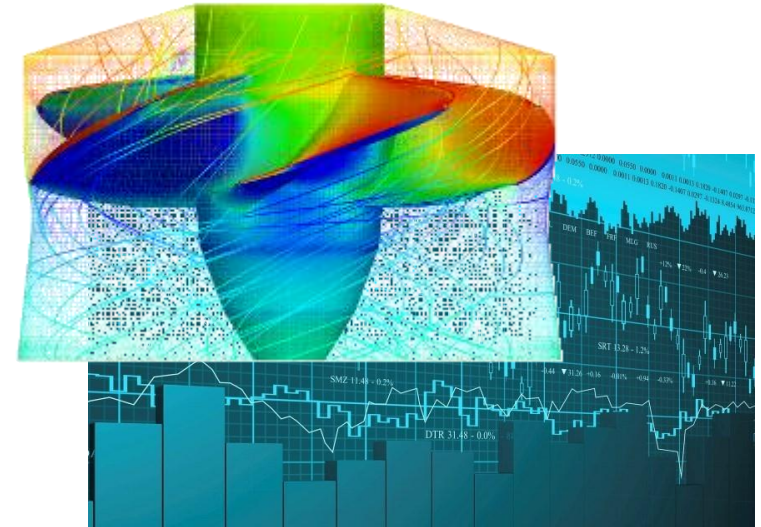
## Objectives

- Fusion of decision support data sources
- Adaption of models

} Could be two different theses

## Outcome / Results

- Decision support methodology



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# Quality classification in Laser welding and development of an HMI software architecture

Ανάπτυξη μεθόδων κατηγοριοποίησης της ποιότητας των συγκολλήσεων και δημιουργία της αρχιτεκτονικής ενός λογισμικού για την παρακολούθηση της ποιότητας

## Motivation of the Thesis

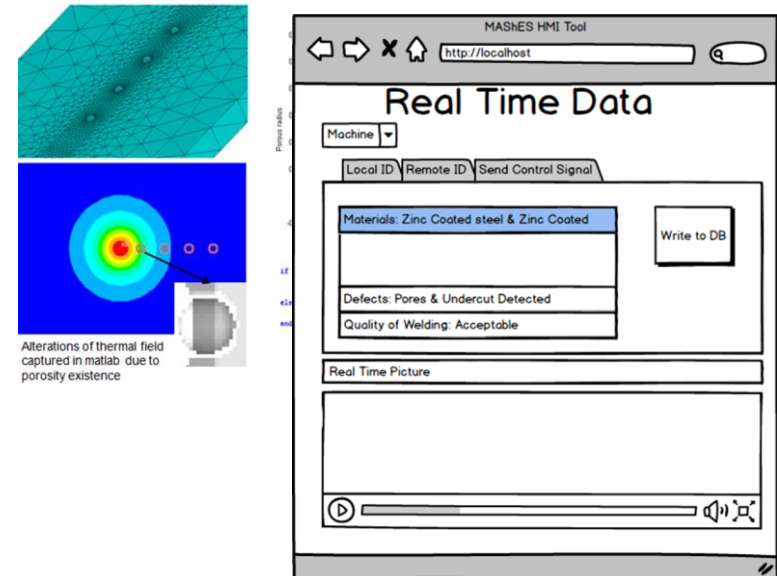
- New classification techniques investigation and development
- Monitoring of quality in laser welding from an operator

## Objectives

- Processing of raw image and video data
- Testing new or existing classification techniques for the quality of Laser welding process
- Definition of the architecture of HMI software

## Outcome / Results

- Evaluation of classification and image processing techniques more appropriate for laser welding
- Execute classification based on real image and video data
- Examine and propose an architecture for an HMI quality monitoring software



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# VR assembly & simulation of a laser processing head and integrated camera box for laser welding and cladding operations

Προσομοίωση και συναρμολόγηση laser κεφαλής και ενσωματωμένης κάμερας σε laser διεργασίες μέσω εικονικής πραγματικότητας

## Motivation of the Thesis

- VR assembly of a laser head with a new multi-spectral camera device
- Simulation of the laser path through the optics of the head and camera
- Investigation of the new design in robotics applications of laser processing

## Objectives

- VR assembly
- Simulation of laser path through optics
- Simulation of laser robotics systems

## Outcome / Results

- Evaluation of the optics design in a new camera device
- Feasibility study for robotic laser operations with the head and a new camera device
- Visualization prior production



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# Design optimization of hybrid mechanical components

## Βελτιστοποίηση υβριδικών μηχανολογικών εξαρτημάτων

### Motivation of the Thesis

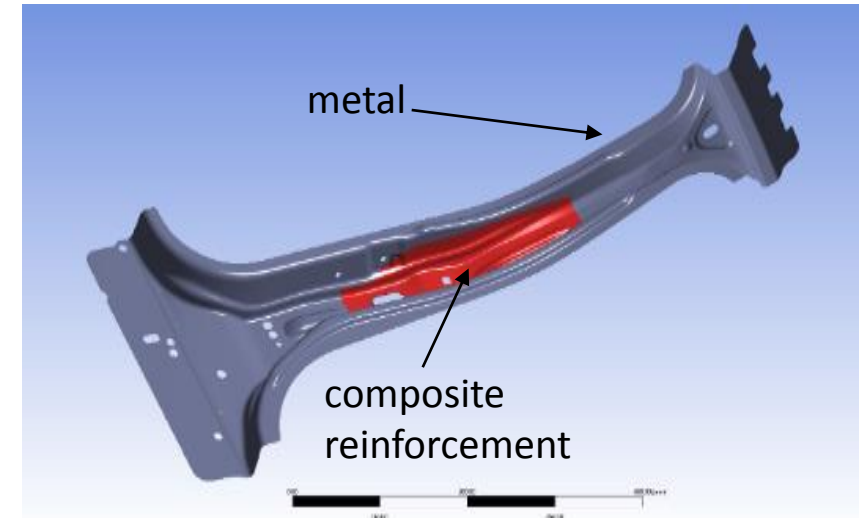
- Composite/metal multi-materials (aka hybrid) are gaining more and more the interest of automotive and aeronautical industries
- Need to develop tools for mechanical design
- Need to develop tools that simulate the manufacturing process

### Objectives

- Development of a computational design tool based on 3D Finite Element (solid modeling) simulations and optimization algorithms
- The tool must be able to provide the optimal values for the design variables involved in the problem (number of layers, stacking sequence, thickness of metal) and the desirable strength of the bondline.
- The set-up will be implemented in ANSYS workbench.

### Expected Outcome

- A practical computational mechanical design tool (framework).
- Verification of the method to simple patched geometries.
- Show the effectiveness of the tool and the sensitivity of the optimization parameters .



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# Numerical calculation of residual stresses in hybrid mechanical components

Αριθμητικός υπολογισμός παραμενουσών τάσεων υβριδικών μηχανολογικών εξαρτημάτων

## Motivation of the Thesis

- Composite/metal multi-materials (aka hybrid) are gaining more and more the interest of automotive and aeronautical industries
- Need to develop tools for calculating the residual stresses during Automated Tape Placement mfg process

## Objectives

- Development of thermo-mechanical computational models based on 3D Finite Element (solid modeling)
- Calculation of residual stresses based on process and material parameters
- The set-up can be implemented in ANSYS.

## Expected Outcome

- A practical computational mechanical design tool (framework).
- Verification of the method to simple patched geometries.



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# Modelling of Additive Manufacturing of Concrete Materials

Μοντελοποίηση Τρισδιάστατης Εκτύπωσης Κατασκευαστικών Υλικών

## Motivation of the Thesis

- A hybrid AM and subtractive machine will be developed that will enable automation in the construction sector. The AM process of the printing of Concrete material will be modelled in Matlab.

## Objectives

Creation of a viscous flow model that will take into account the

- Mechanical and Rheological properties
- Forces of extrusion/pumping/deposition
- Cooling and solidification
- Process Speed

## Outcome / Results

- Simulation model of the HINDCON AM Process
- Can help in the design of the Material/Process
- 2D models



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# Simulation of a hybrid machine for additive and removal manufacturing processes

Προσομοίωση υβριδικής μηχανής για παραγωγικές διαδικασίες προσθαφαίρεσης υλικού

## Motivation of the Thesis

- A hybrid AM and subtractive machine will be developed that will enable automation in the construction sector. The different processes that are followed during the operation of the machine will be simulated

## Objectives

Creation of a process simulation that will take into account the:

- time between consecutive layers,
- thickness of deposit depending on process step,
- synchronization of start/stop of robot
- trajectory and tool control,
- Change between additive and subtractive tools

## Outcome / Results

- Simulation model of the AM and Subtractive Process
- Visualization of the sub-processes
- 3D model



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# Decision support system for Additive Manufacturing

Ανάπτυξη συστήματος υποστήριξης λήψης αποφάσεων σε διεργασίες Additive Manufacturing

## Motivation of the Thesis

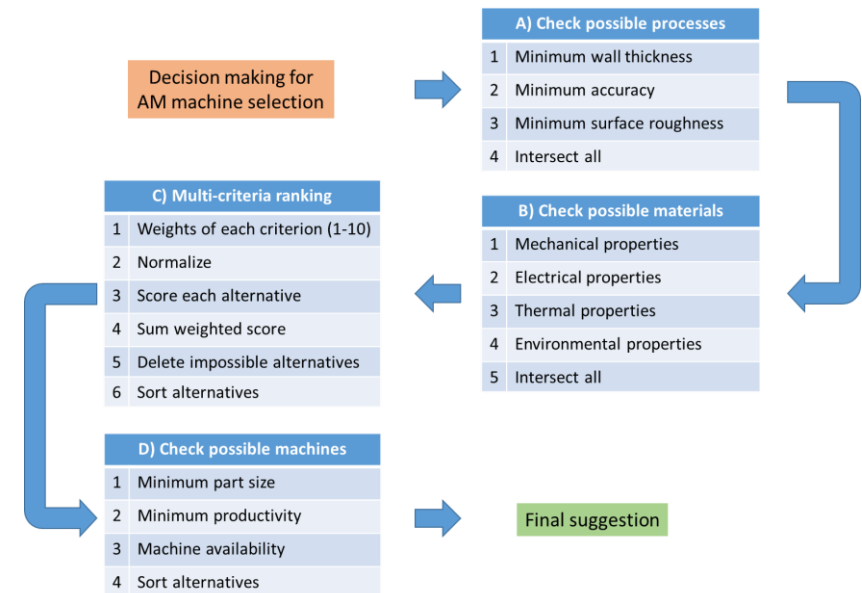
- Additive manufacturing technologies constantly increase in share
- End users are unaware of capabilities and limitations of available processes
- Selection of the process is often done arbitrary

## Objectives

- Establish a series of KPIs important to the end users
- Develop a decision making algorithm for AM production
- Integrate previously developed algorithm in a software tool

## Outcome / Results

- Decision making algorithm for appropriate AM process selection
- Decision making algorithm for appropriate machine selection
- Integration in an AM Decision Support software



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# Production Planning for Additive Manufacturing

## Προγραμματισμός Παραγωγής για Additive Manufacturing

### Motivation of the Thesis

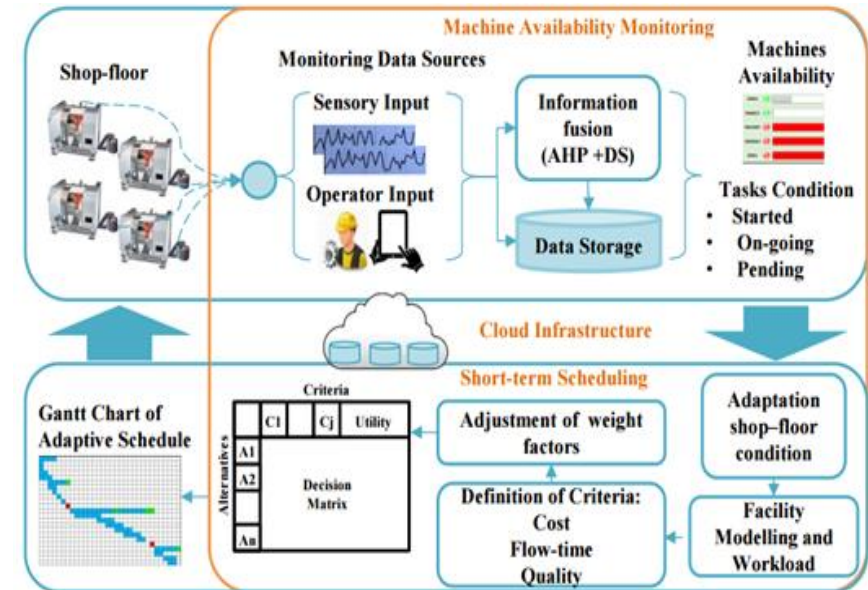
- Additive manufacturing technologies constantly increase in share
- Need to use multiple machines or manufacture multiple parts in a single machine run for higher volumes of production
- Production planning tools and methods for AM do not exist

### Objectives

- Establish and implement a nesting method based on collision detection algorithms
- Create a tool to calculate production cost and time for multi-part production
- Create an ERP method & tool for dynamic (re)scheduling of production plan in multiple local or remote machines

### Outcome / Results

- Framework and tools to manage high volume AM production



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# Web-enabled distributed Additive Manufacturing machines

## Διασυνδεδεμένες απομακρυσμένες μηχανές Additive Manufacturing

### Motivation of the Thesis

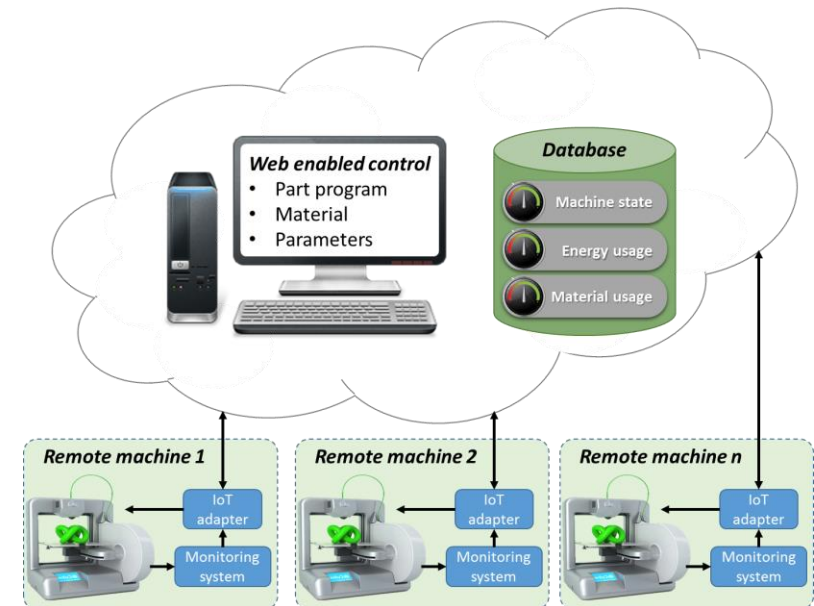
- Additive manufacturing technologies constantly increase in share
- Distributed manufacturing can significantly contribute in cost reduction and sustainable manufacturing

### Objectives

- Design and implement an IoT module to enable remote control of AM machines
- Create a remote monitoring system reporting to a cloud-based repository to enable near real-time ERP

### Outcome / Results

- Web enabled/IoT machine interface
- Web enabled/IoT logging interface
- Cloud-based logging repository, including real-time machine status



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# Automated assembly planning method

## Μέθοδος αυτοματοποιημένου προγραμματισμού συναρμολόγησης

### Motivation of the Thesis

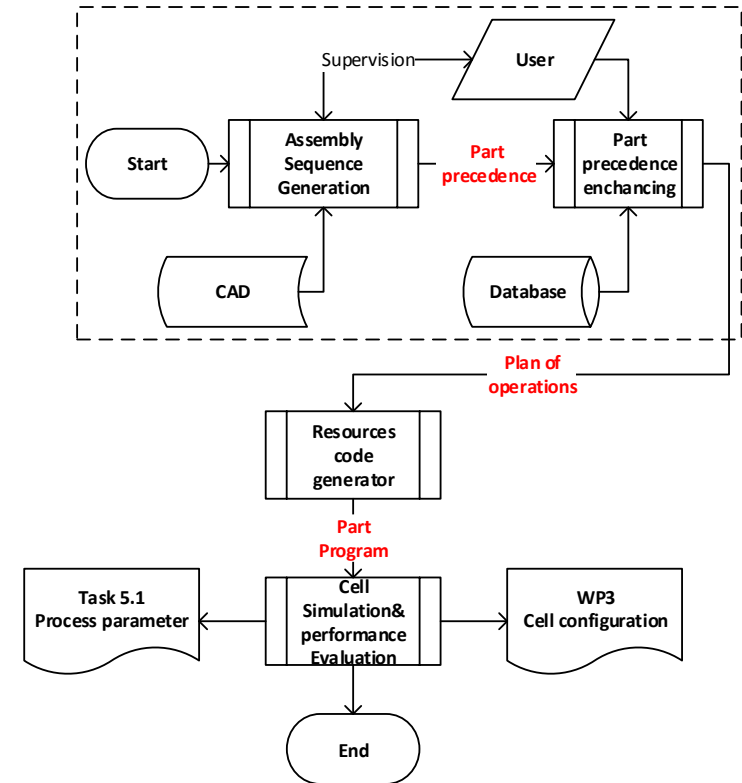
- Different products of the same family share typologies but differ in details
- Optoelectronic products often evolve over time
- Different variants of products require different assembly plans

### Objectives

- Establish a generic method for automated assembly planning method
- Implementation in an assembly planning component

### Outcome / Results

- Software component for automated generation of an assembly process plan based on the CAD file of the product



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