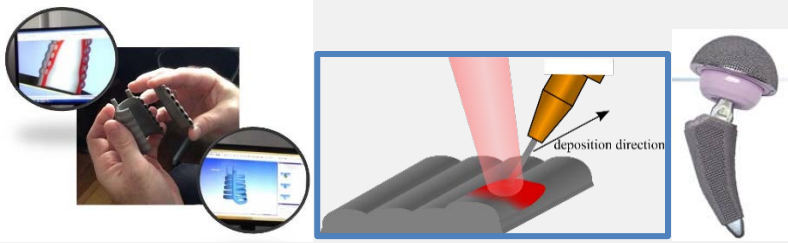
Updated: 21/12/2016

Syllabus for



P20 – Additive Manufacturing Technologies for Metals

Credits	7.5 credits
Examiner	Lars Pejryd, Örebro University
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Target group	Doctoral students in production and/or product development who want to gain knowledge in current scientific methods and tools for additive manufacturing of metal components.
Fee for industrial members	-
Prerequisites	Doctoral students in Product Design or Production Technology or equivalent research area.
Aim	The course covers the processes that today are in focus for academy and industry, i.e. powder bed fusion (SLM, EBM, ..) and directed energy deposition (wire and blown powder, spray forming). It covers both design, inspection and shape aspects of importance for the different processes. It also

give future aspects (industrial and scientific).

The course is directed to methods that are used to manufacture metal components directly. It will not cover indirect methods aimed at green body manufacturing or manufacturing of sand molds for castings.

Teachers / tutors

The experiences from the teachers cover the main technologies that today are used for additive manufacturing of metal components.

Lars Pejryd at ORU covers the SLM process and CT process for inspection.

Lars-Erik Rännar at MiUN covers the EBM process.

Joel Andersson at University West covers the blown powder process.

Lennart Malmsköld at University West covers the wire process and spray forming.

Pavel Krakmalev at Karlstad University covers the areas of powders, microstructure and residual stresses.

Learning outcomes

After the course, the student shall demonstrate knowledge and understanding of:

- When additive manufacturing is an appropriate choice (geometric shape, series size, material, etc.).
- Properties of different AM processes.
- Different manufacturing equipment.
- Tools for manufacturing preparation, building and inspection.

The student shall demonstrate skill and ability in:

- Describing prerequisites and capabilities for the different methods.
- Discussing when and how to utilise the different methods and restrictions in the possibilities to use the different methods.
- Discussing research needs and development potential for the respective methods.

Contents

The course contains the following topics:

- Introduction to metal AM, incl overview of technologies, materials and inspection methods.
- Manufacturing preparation and design for metal AM, incl cost for analysis of competing technologies, standards.
- Typical applications today, e.g. repair, remanufacturing, prototypes, new designs, …
- Each technology pro's and con's, i.e. benefits, special considerations, limitations, etc through theory and lab
    - EBM
    - SLM

    - Blown powder (laser based powder nozzle)
    - Wire deposition
    - Spray forming
- Implications on the production system(s), qualifications, control
- Summary, discussions, future for metal AM.

Organisation

Four physical meetings in different locations, 2 days per meeting.

Literature

Gibson, Rosen, Stucker. Additive Manufacturing Technologies. Rapid prototyping to Direct Digital Manufacturing. Springer, latest issue,

http://www.bokus.com/bok/9781493921126/additive-manufacturing-technologies/

The European roadmap for standardization, SASAM

Examination

Each session is examined by written homework on the topic given, i.e. in total 4 reports are to be written. The scope and level for each written report will be clearly given.

The grades are passed/not passed.

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