

EPFL reasearch activities in additive manufacturing

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Content

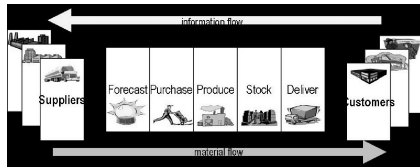
Research activities at LGPP-EPFL

AM Initiative at EPFL

LGPP specific expertise

Operation management:

- *Supply chain management*
- *Extended and virtual enterprise*
- *Production Planning & control*
- *Integration of Human aspects*
- *Modeling & simulation*



Production processes:



- **Additive production process**
- **Selective laser sintering/melting**
 - *Modelling and simulation of SLS/SLM*
 - *Rapid tooling,*
 - *Rapid manufacturing,*
 - *Thermal optimization of parts.*

Research and developments activities at LGPP

SLS equipments available at LGPP



Standard EOSINT M250



Experimental machine

- *CO2 laser*

-

- *Bronze Powder*

- *50 μm layers*

- *Nd:YAG pulsed / Ytterbium-fiber CW lasers*

- *controlled atmosphere*

- *Ti, Ni, Au, Ag, 316L, H13,...*

- *up to 20 μm layers*

Main challenges for SLS-SLM(-EBM-DMD)

List of challenges and of the associated research directions

Challenge	EPFL Activities/Projects	Benefits for the process
(a) Extension to new materials		
	<p><i>AM for Metal Matrix Composite</i> <i>AM of multimaterial parts</i></p>	<p><i>part optimization</i> <i>opening to new applications</i></p>
(b) Improved part qualities		
	<p><i>Strategies to reduce therm. stresses</i> <i>Strategies to get higher accuracy</i> <i>Power manag. to increase productiv.</i></p>	<p><i>reduction of postprocessing</i> <i>cost and waste reduction</i> <i>opening to new applications</i></p>
(c) Process control and monitoring		
	<p><i>Control of powder bed deposition</i> <i>Control of powder consolidation</i> <i>Strategies for feedback control</i></p>	<p><i>more reliability</i> <i>part certification</i></p>

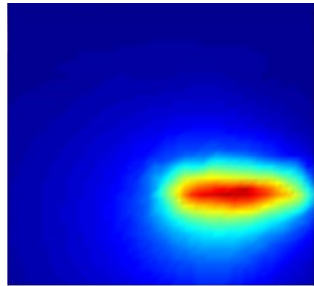
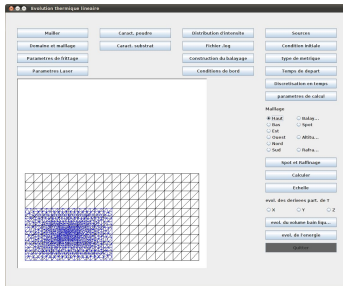
Research activities at LGPP (1)

Development of a comprehensive finite element model:

- ***Parameters optimization, test of control strategies***

Input

Output



- *scanning strategy, laser param.*
- *powder thermal properties*
- *powder mechanical properties*

- *temperature field/part geom.*
- *thermal stresses/deformation*
 - *possibly microstructures*

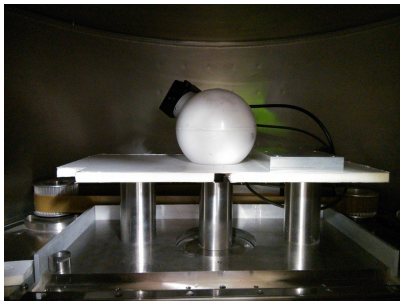
Research activities at LGPP (2)

Development of specific set-up for powder diagnoses

- ***Optimization for new materials***

Absorptivity measurements

Conductivity measurements



- *laser-matter coupling*

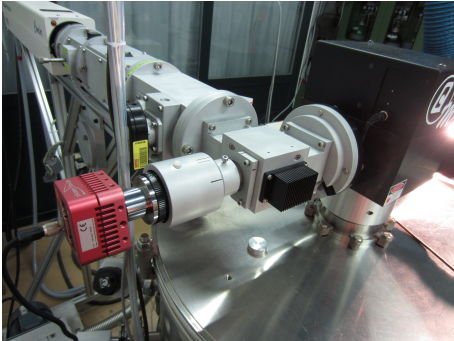


- *dynamic of energy flow*

Research activities at LGPP (3)

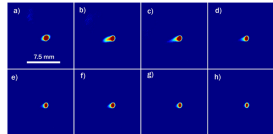
Development of specific set-up for process vision

- **Process control and monitoring**



Essai de validation sur acier maraging on lit de poudre

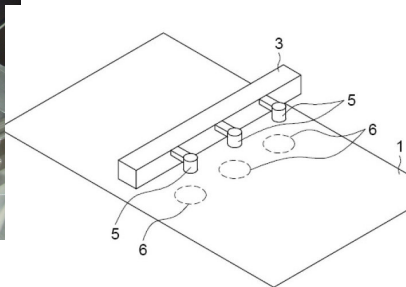
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Parcours [m]	Vitesse [mm/s]	Mode [-]
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Stratégie de scan		
Distance x [mm]	Distance h [mm]	Correspondance [-]
30	0.01	1 ligne



Research activities at LGPP (4)

Detection methods based on eddy-current measurements

- ***Process control and monitoring***



2 AM Initiative at EPFL

Increased recruitment in the field of manufacturing

Existing chairs

LAB	Prof	Field
<i>INSTANT-LAB</i>	<i>Prof. S. Henein</i>	<i>micromechanical and horlogical design</i>
<i>LTMM</i>	<i>Prof. R. Logé</i>	<i>metallurgy and metal forming</i>

Newest chair

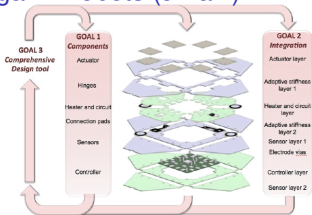
LAB	Prof	Field
<i>tbf.</i>	<i>almost found</i>	<i>Multi-scale manufacturing technologies</i>

Planned chairs

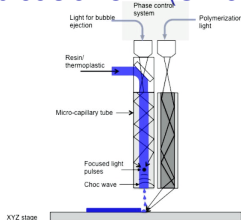
LAB	Prof	Field
		<i>High precision robotics</i>
		<i>Design of parts with gradient-properties and multi-materials</i>
		<i>AM of heterogeneous parts (embedding sensors, electronics)</i>

Four new Faculty (STI) Projects

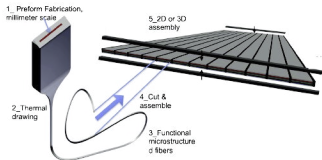
Origami Robots (J.Paik)



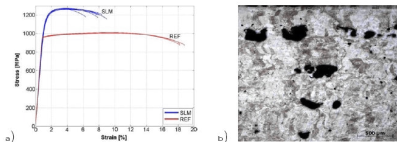
High precision 3DP (C.Moser)



Structured fibers (F.Sorin)



Tailoring microstruc. (R.Logé)



3D Printing Service at EPFL

Three 3D printing machines are now up for polymers

PolyJet

FDM

SLS



Great success

- *23 labs*
- *49 projects (34 research, 15 education)*
- *Plan to invest in a new metal machine at Microcity*