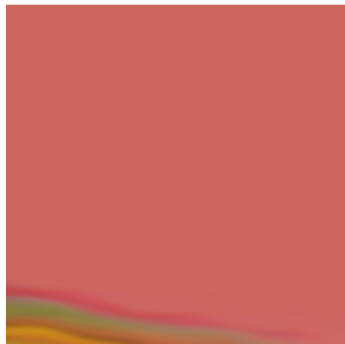
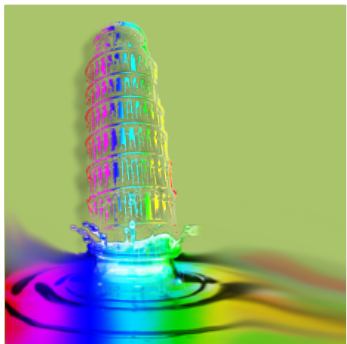
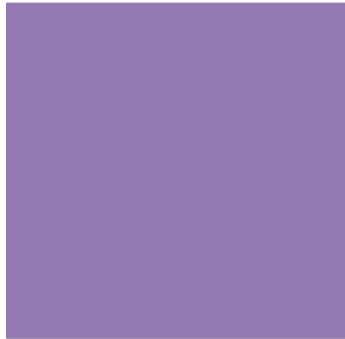


Micro e Nano Sistemi

G. Vozzi



+ Contatti

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- Carmelo De Maria
 - carmelo.demaria@centropiaggio.unipi.it



+ Siti internet di riferimento

- <http://www.centropiaggio.unipi.it/course/micro-e-nanosistemi.html>
- <http://dionisio.centropiaggio.unipi.it/gvozzi/default.aspx>
- <http://dionisio.centropiaggio.unipi.it/cdemaria/default.aspx>

+ Programma preliminare del corso

- Microfabbricazione 2D
- Microfabbricazione 3D e tecnologie di prototipazione rapida
- Applicazioni al settore biomedico con esempi di casi studio
- Software open-source (CURA and MESHLAB)



+ Modalità d'esame

- Una domanda per ogni parte del corso (2D e 3D fabrication)
- Presentazione di un articolo



+ Materiale didattico

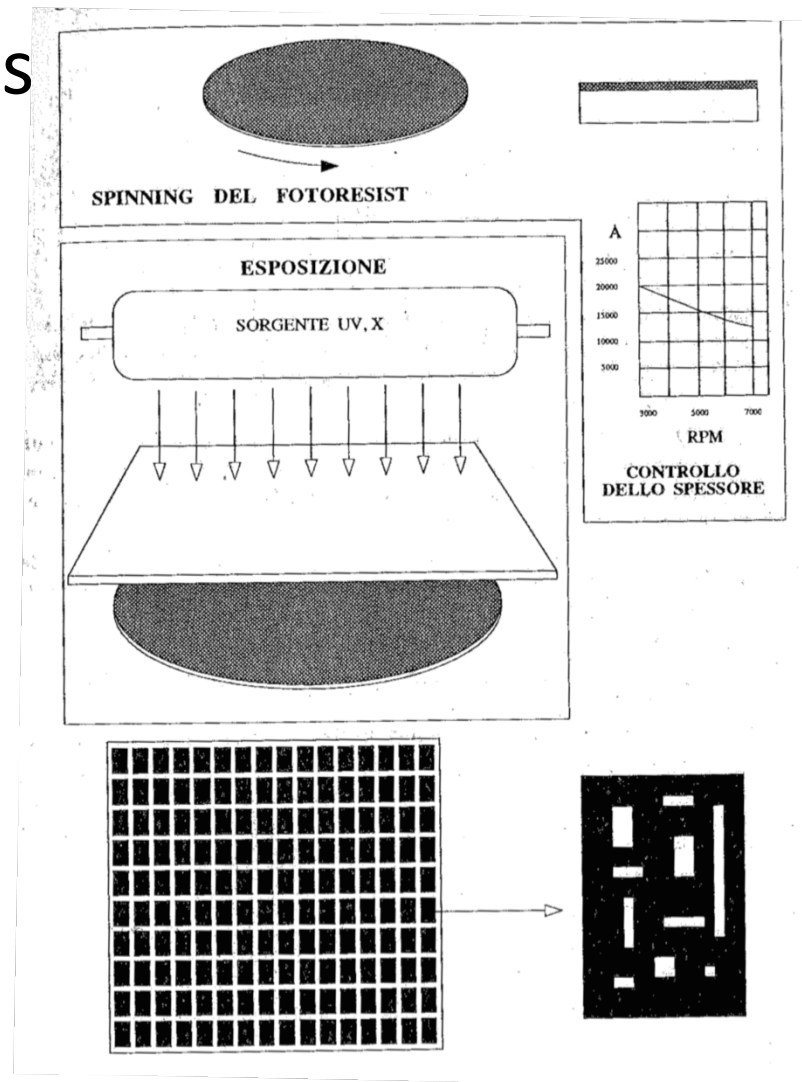
- Slide ed appunti forniti dal docente
- Libri di riferimento:
 - Madou, Fundamentals of Microfabrication, CRC Press
 - Gebhardt, Rapid Prototyping, Hanser Verlag



MICROFABBRICAZIONE 2D

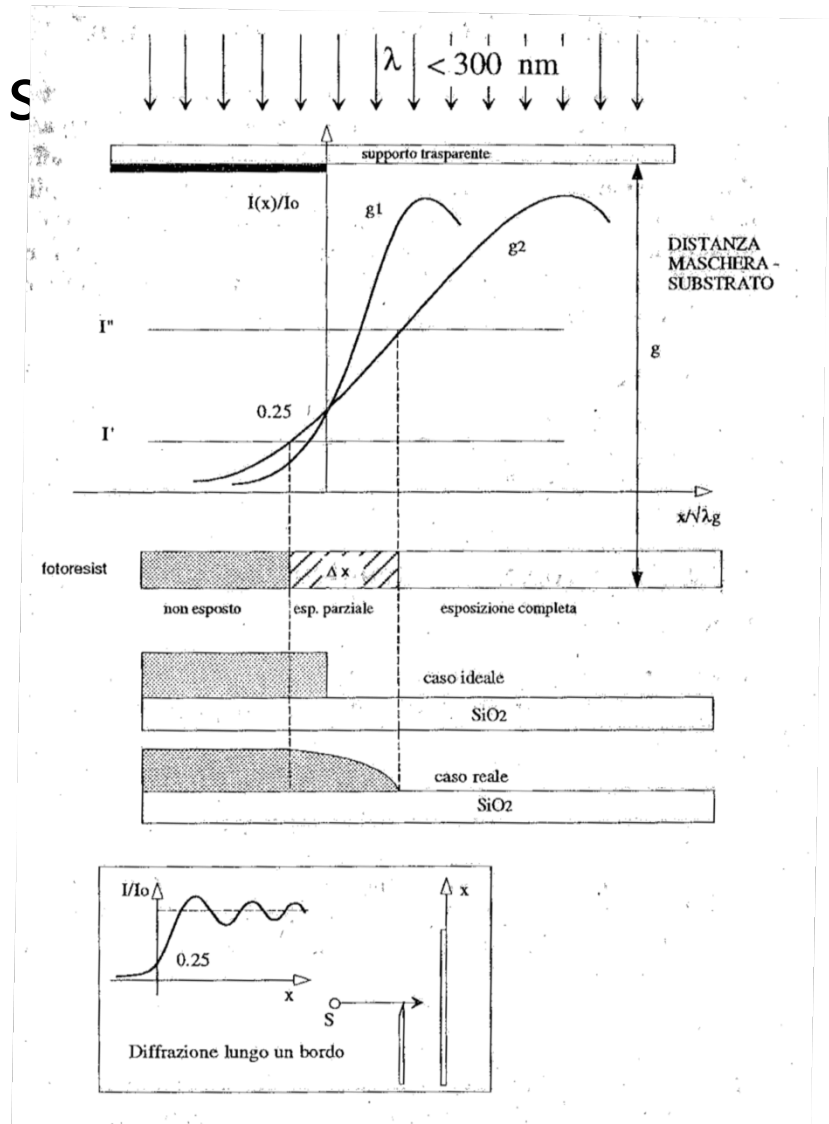
+ Litografia

- Dalle proprietà del s di circuiti integrati

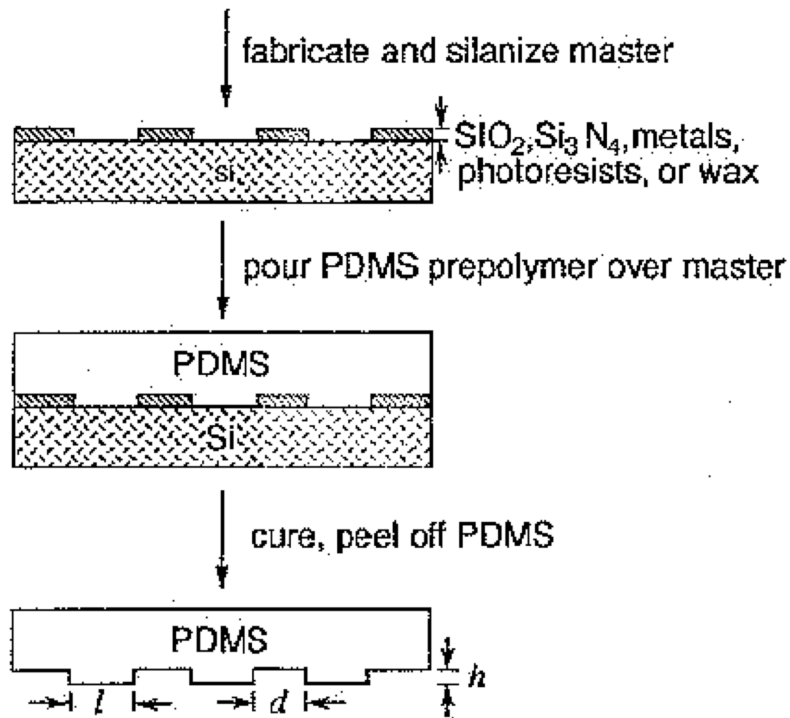


+ Litografia

- Dalle proprietà del s
di circuiti integrati



+ Soft-litografia



MICROFABBRICAZIONE 3D

+



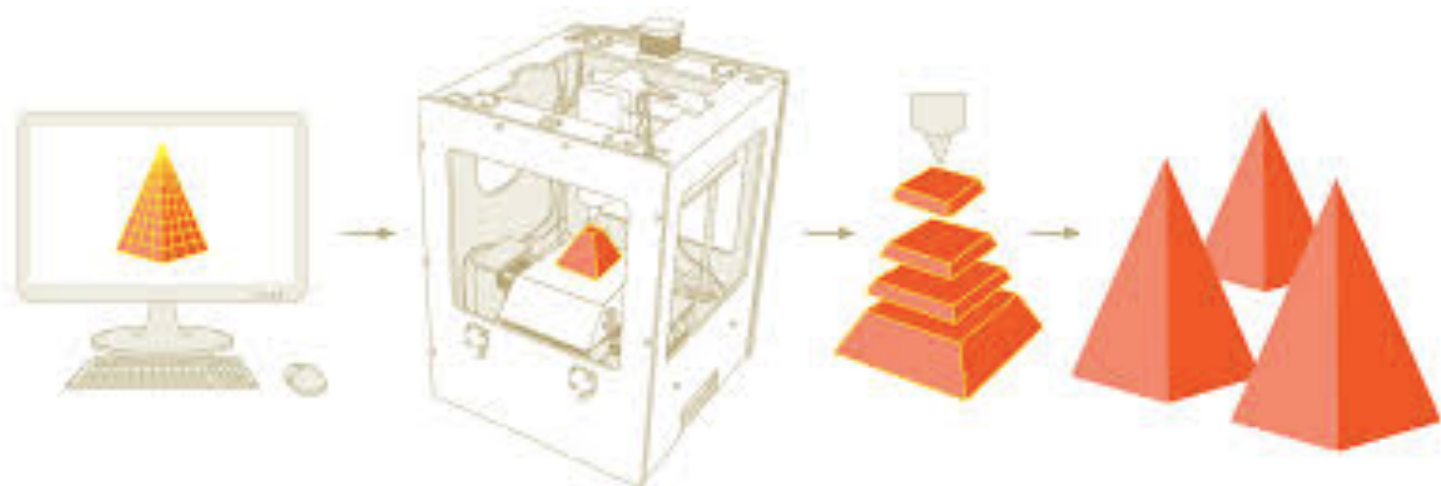
3D fabrication

Additive

Subtractive

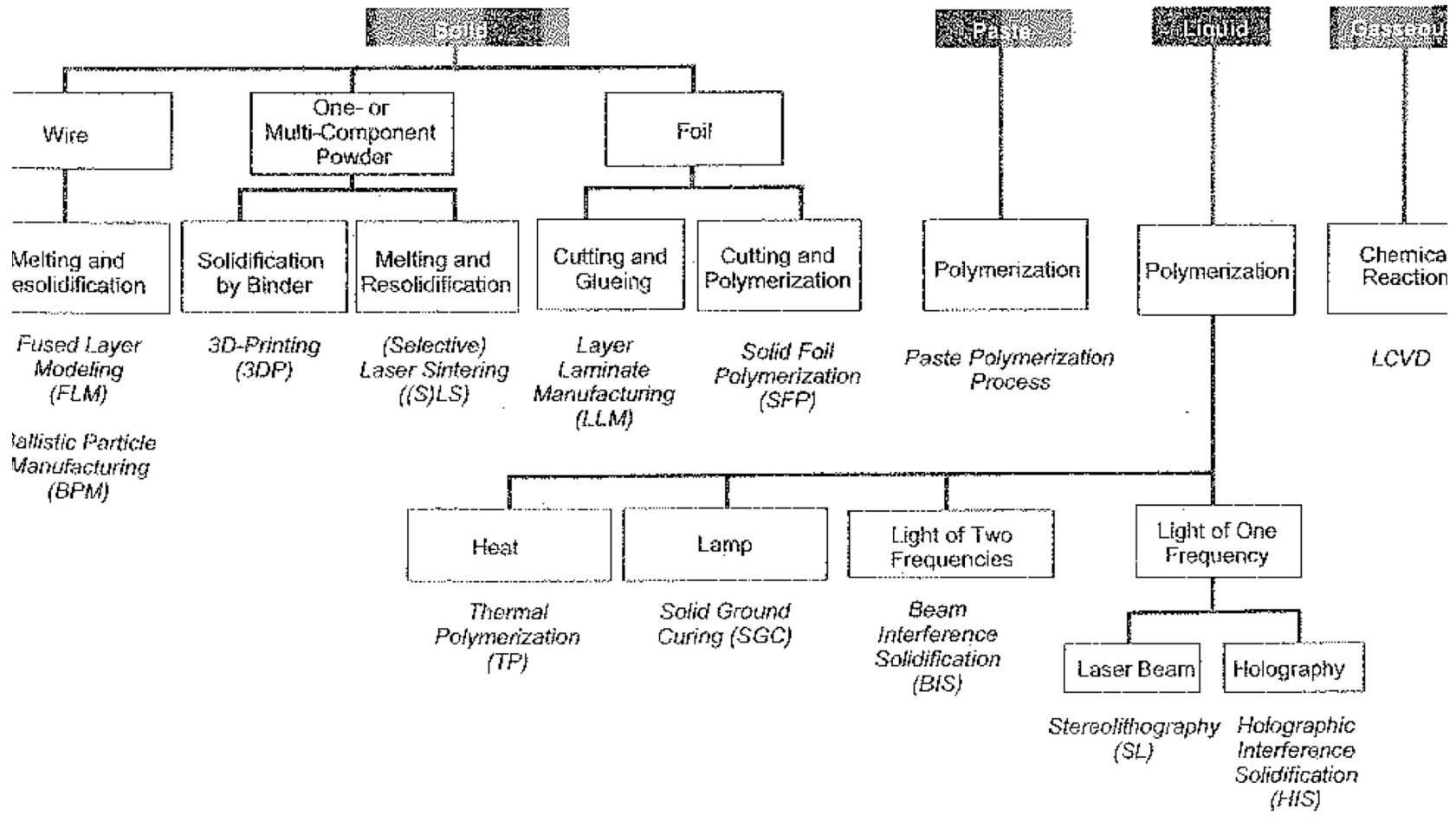
+ 3D printing

- 3D printing (or Additive Manufacturing) is a process of making a three-dimensional solid object of virtually any shape from a digital model.
- 3D printing is achieved using an additive process, where successive layers of material are laid down in different shapes.



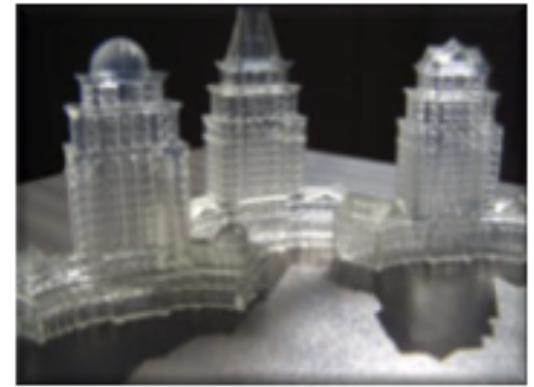
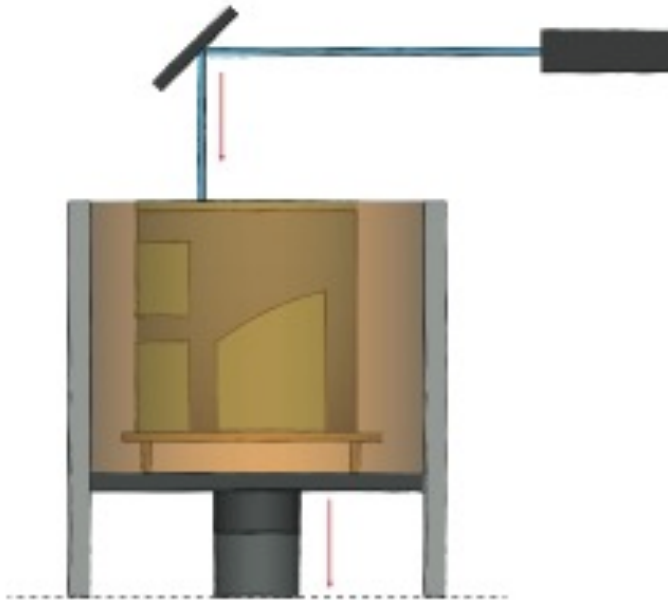


Additive manufacturing world



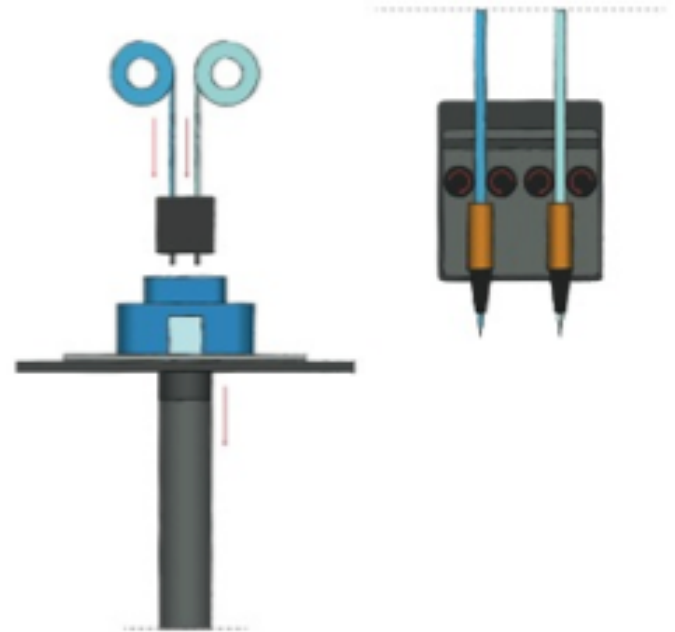
+ Available technologies

- Solidification of liquid materials
 - Photo-polymerization process



+ Available technologies

- Generation from the solid phase:
 - incipiently or completely melted solid materials, powder, or powder mixtures:
 - Extrusion (FDM),
 - Ballistic and
 - Sintering processes



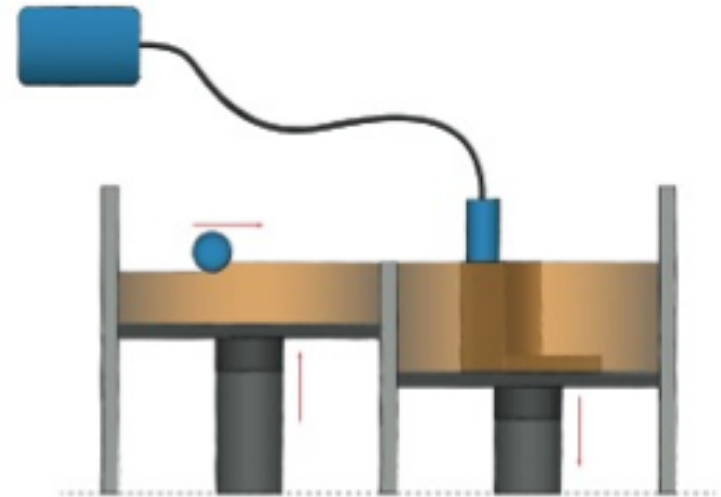
+ Available technologies

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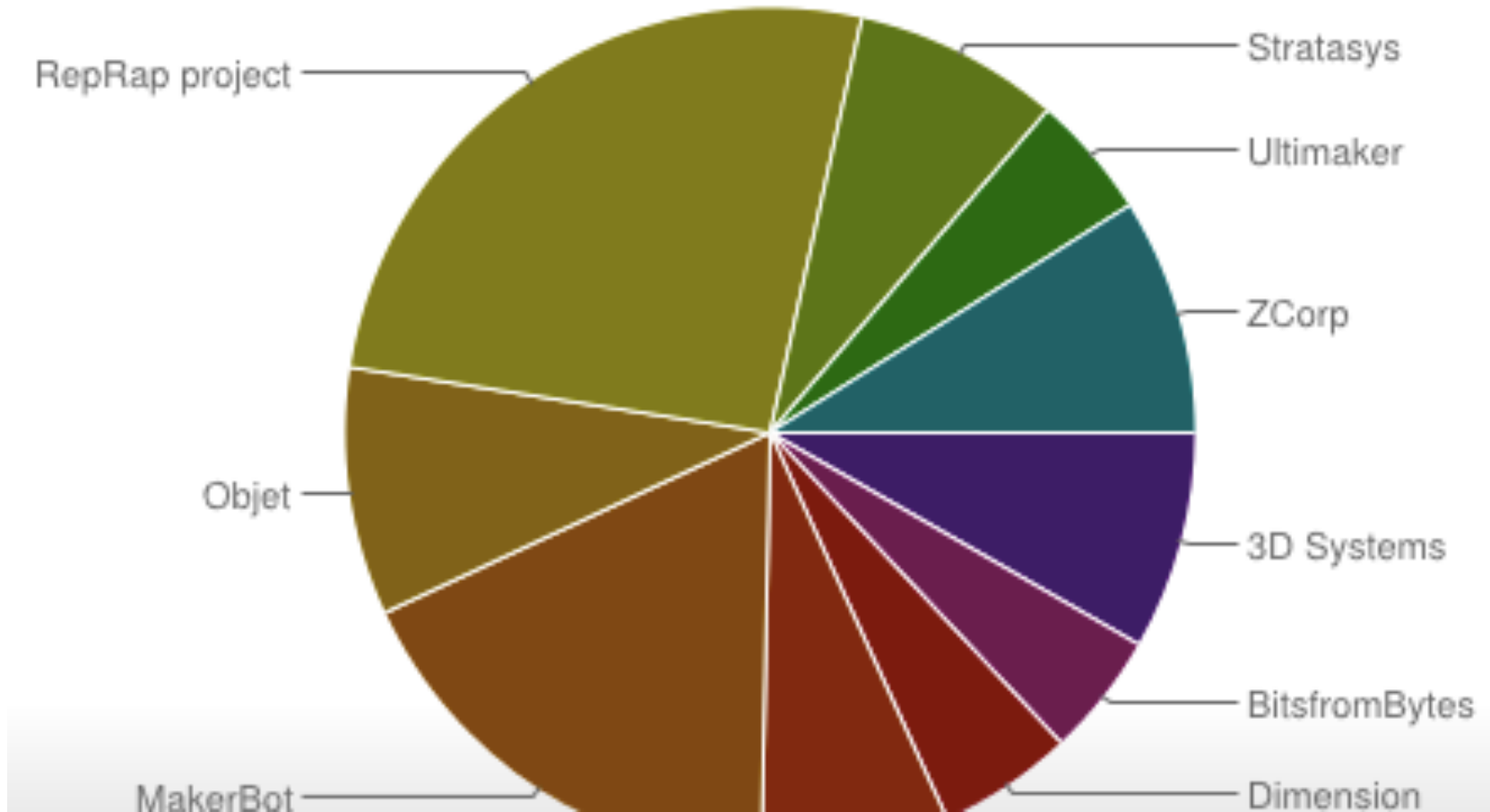


+ Available technologies

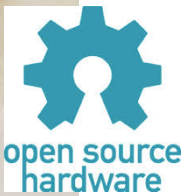
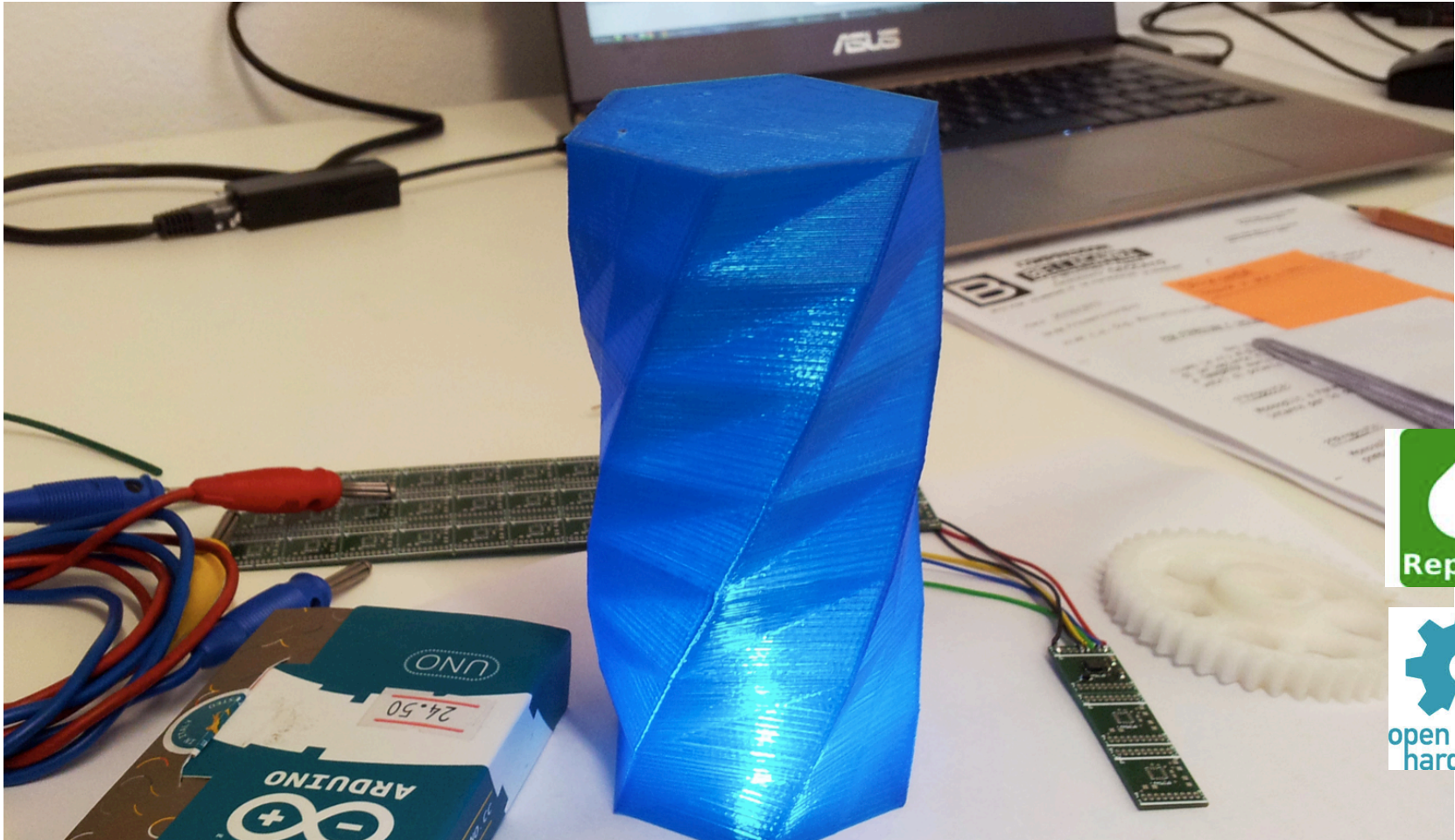
- Generation from the solid phase:
 - Conglutination of granules or powders by additional binders
 - 3D inkjet printer



+ 3D printer as a whole

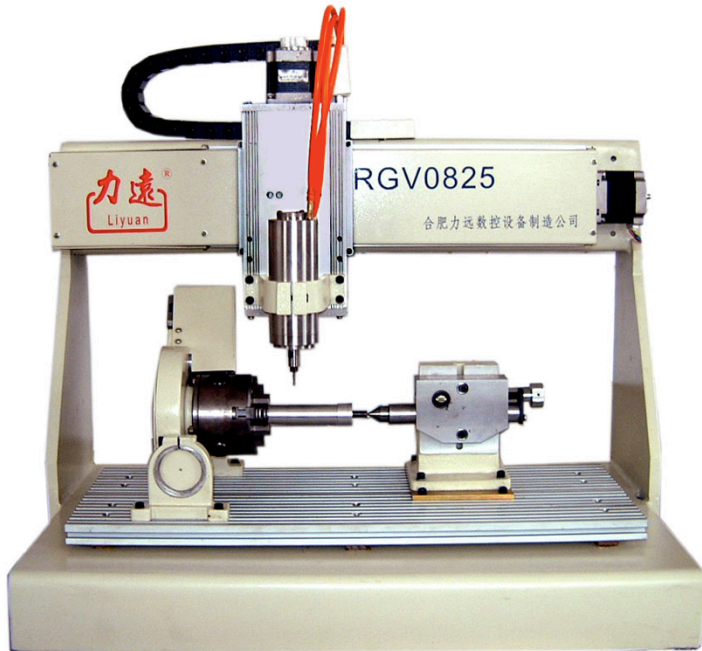
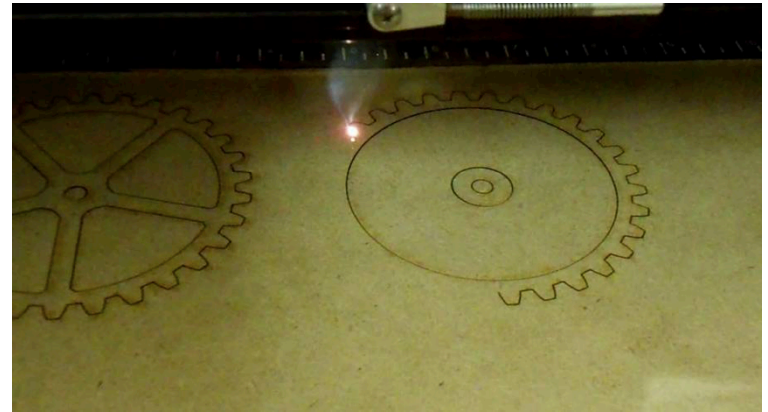


+ The RepRap Project



+ Other fabrication technologies

- Subtractive technologies
 - Laser cutter
 - CNC milling machines



+ **Analisi multifisica agli elementi finiti**



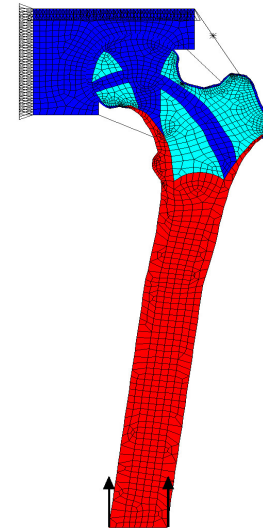
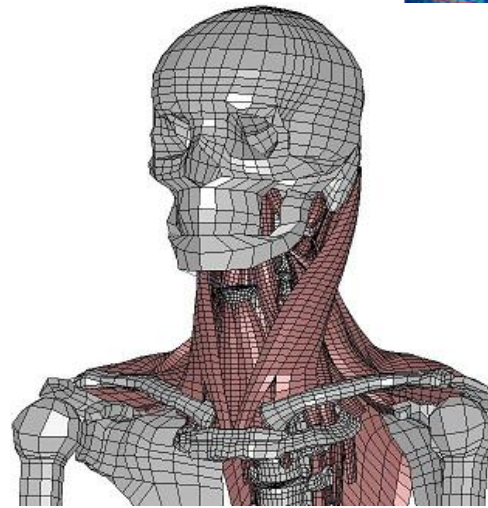
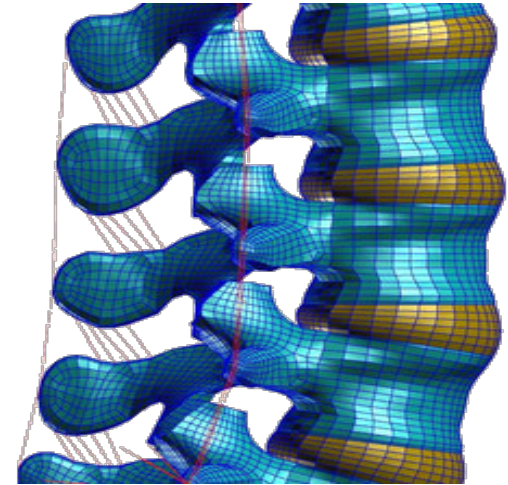
+ Analisi agli elementi finiti

- Metodo per la risoluzione **numerica** di una equazione differenziale, sia essa alle derivate totali o parziali
- Più precisamente si tratta di un metodo per approssimare una equazione differenziale con un sistema di equazioni algebriche



+ Analisi agli elementi finiti

- Elementi
- Nodi
- Funzioni Forma
- Gradi di libertà



+ Comsol Multiphysics

