Research Group Presentation

Technical Drawing and Design Methods in Engineering

DIMA – Dipartimento di Ingegneria Meccanica e Aerospaziale
Via Eudossiana 18

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FACOLTÀ DI INGEGNERIA
CIVILE E INDUSTRIALE

SAPIENZA
UNIVERSITÀ DI ROMA

Research team

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- *Reverse Engineering*
- *Mechanical Design*
- *CAD, CAE, CAT&I Systems*
- *Additive Manufacturing*
- *Topological Optimization*

Collaborators, Students and ex-students involved:

Robinson Guachi, Ph.D. Student - *Virtual prototyping of bioengineering problems in correlation with prof. Marinozzi*

Daniele Cortis, Ph.D Student – *Multibody simulation, CAD-CAE model data exchange*

Micaela De Michelis, *Aluminium foams: modeling and simulation*

Alessandro Dughiero, *Reverse engineering and CAT&I systems*

Marianna Crimeni, *Virtual modeling of medieval war machines*

Research Fields and Skills

- Virtual prototyping in design optimization
  - DACE, DOE analysis and metamodeling
  - Robust design
  - Metal forming and crash analysis
- CAD/CAE/CAM systems and PDM set-up
  - Vertical Integration and oriented toolbox development
- Product-Process integrated design and CIM
  - Design for Additive Manufacturing, Sheet Metal Forming and Injection Molding
  - Lightweight design by topological optimization and lattice structure
- Reverse Engineering
  - Cultural Heritage analysis and restore
  - Shape deviation
  - Tolerance inspection
  - System development
- Virtual Prototyping for Bioengineering application and design

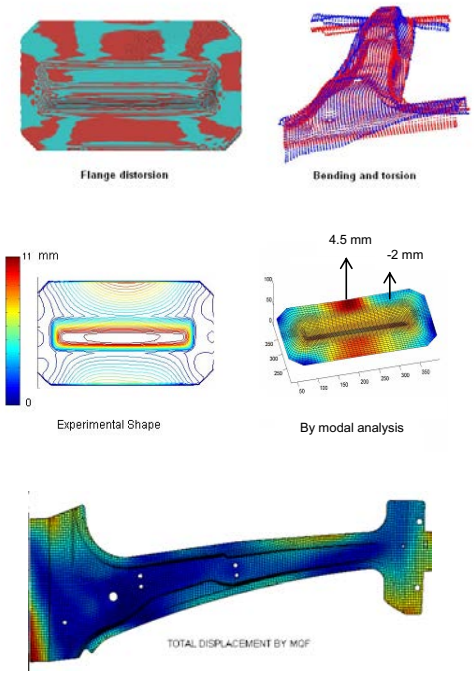
Developed Applications

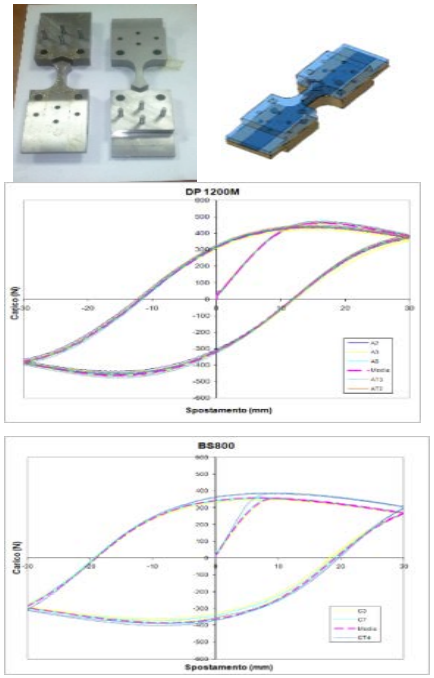
Sheet Metal Integrated (Robust) Design

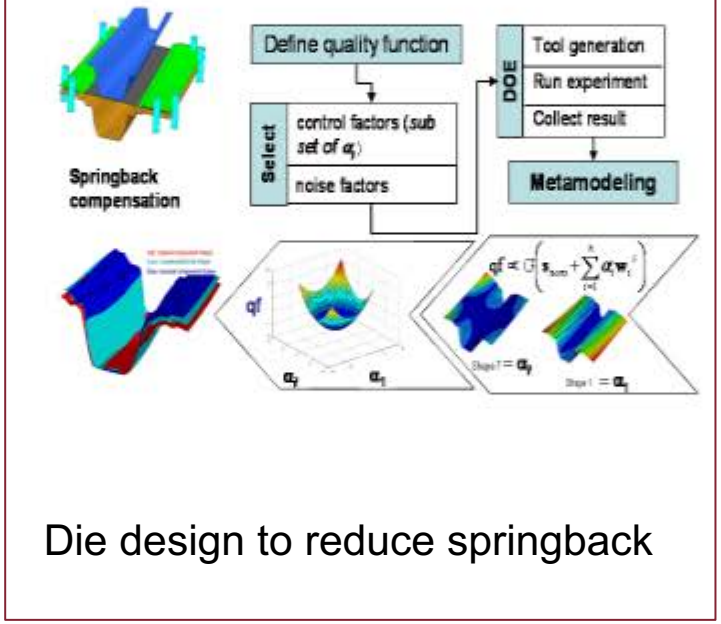
AIM: Develop integrated CAD/CAE tools to support manufacturing process set-up and optimization; quality functions for defect assessment

TOOLS: CAD/CAE systems, Robust Design, Material testing and characterization

Springback Quality Function → Material Characterization → CAD/CAE tool definition







Die design to reduce springback

Developed Applications

Knowledge based design for Exhaust System

AIM: Explore how manufacturing together many pipes from a single longer tube to reduce scraps and tooling set-up

TOOLS: *CAD + knowledge based design; CAE for product-process design; design for bending and hydroforming*

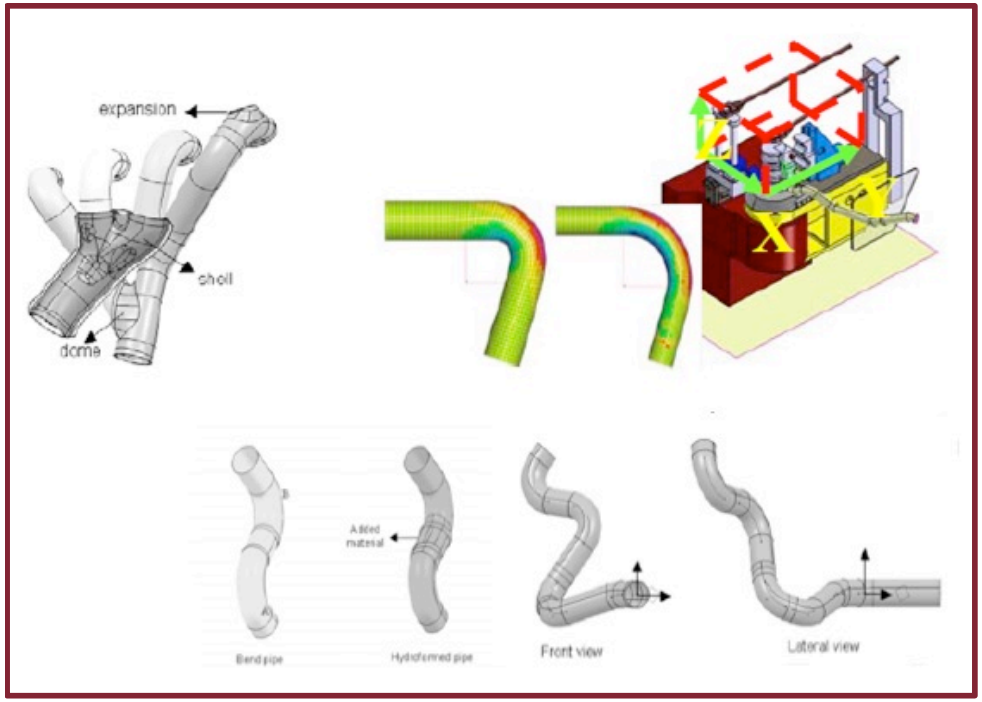
WORKFLOW

Pipe shape analysis
From CAD model and design knowledge: manufacturing constraints definition
(bending, hydroforming, cutting, …)

Design of the Alternatives
Shape reconstruction of aggregated pipes:
- Parting line and cut areas design
- Aggregated tube design

Optimal condition analysis through:
Technological checks:
- Bending tool compatibility
- Bending machine collision
- Hydroforming final thickness, Wrinkling

Economic advantages

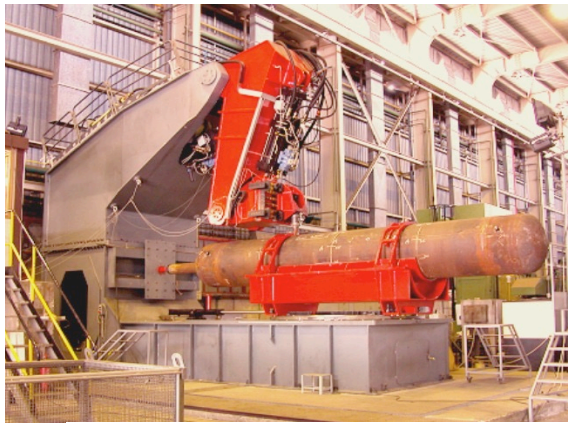


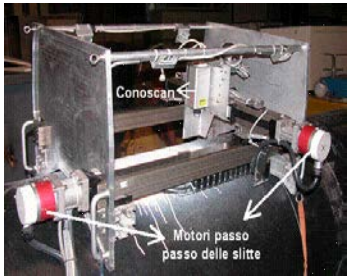
Developed Applications

External Damage of Pipelines

AIM: Acquisition and automatic surface reconstruction of external damage to aid residual strength prevision or operative actions

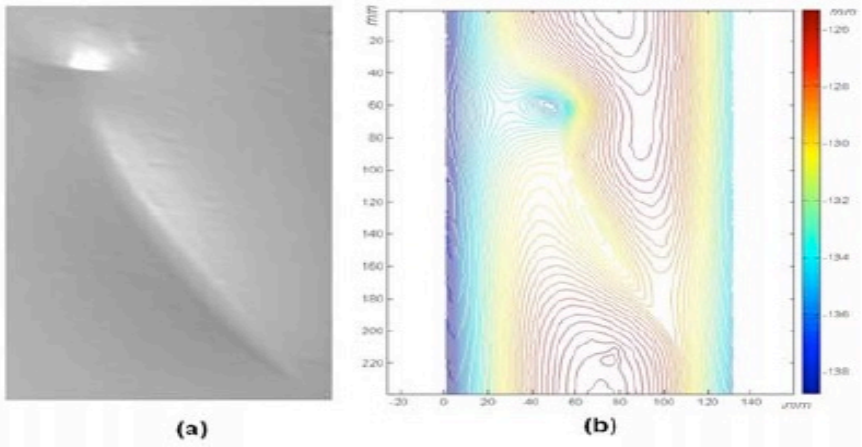
TOOLS: Conoscopic holography, Reverse Engineering, Image analysis

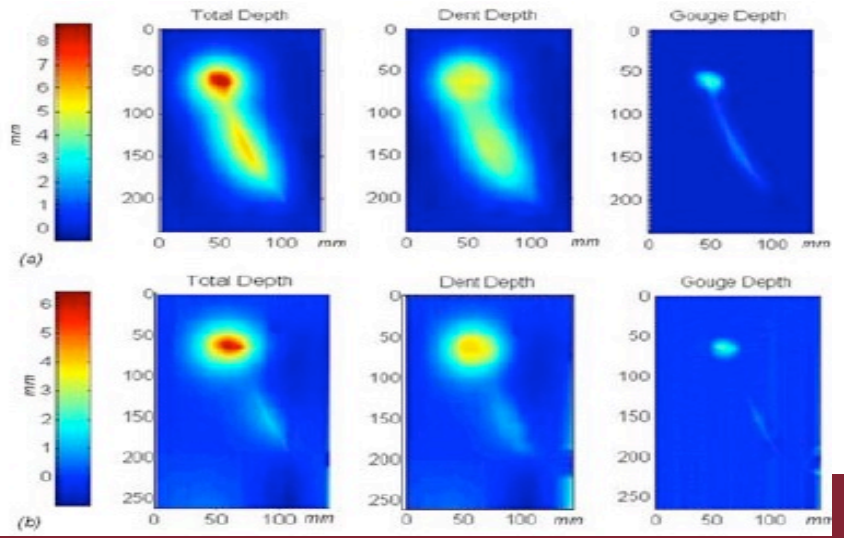




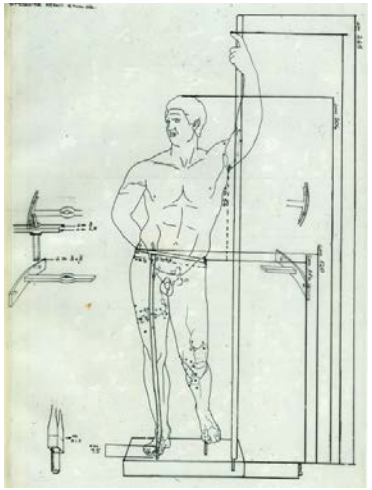
Automatic reconstruction for reliable comparisons, avoiding human error

Automatic recognition of dent and gouge





Developed Applications



•Verifica strutturale statua-supporto a seguito di indagini sperimentali sugli spessori e il livello di danneggiamento (con ISR)

• Analisi e gestione del modello di RE per la meshatura e lo studio della ricostruzione posturale

Information

Statistics

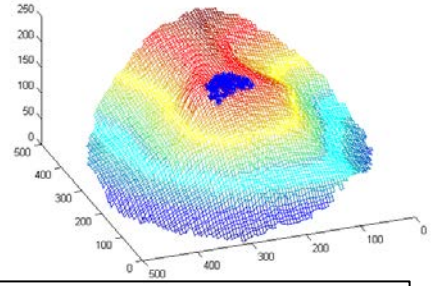
Name : modello definitivo x francesca campana.1

==========

Nb. cells = 1
Nb. points = 2380806
Nb. visible points = 2380806
Nb. activated points = 2380806
Nb. filtered points = 0
Nb. triangles = 4760777
Nb. boundaries = 2
Nb. non-manifold edges = 96
Min extremity: -596,191mm -102,718mm -1336,986mm
Max extremity: 289,927mm 841,892mm 1227,65mm
Dimensions: 886,118mm x 944,609mm x 2564,636mm (2,147m3)
Area = 3,956m2
Volume = 0m3

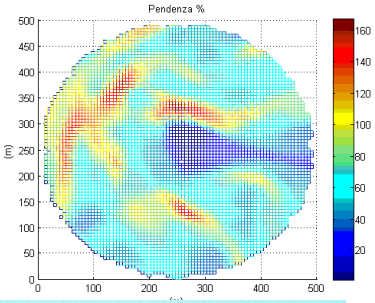
Cultural Heritage Analysis and Restore

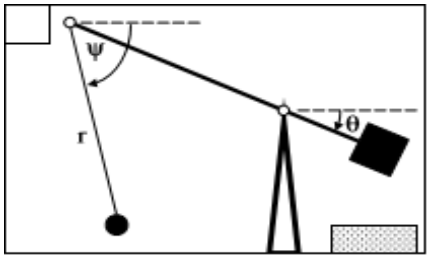
AIM:Virtual reconstruction of medieval war scenarios and virtual modeling of war machines



Area Analysis and external ballistics

VIRTUAL MODEL
made through
assemblying internal and
external ballistics





«state of art», cinematic model and internal ballistics

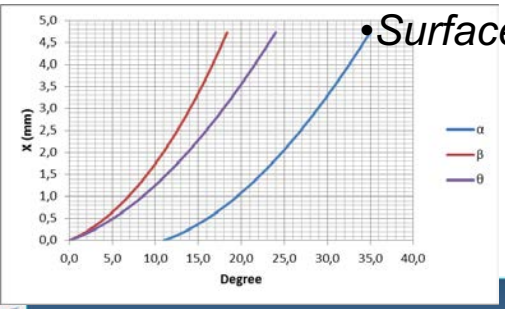
Developed Applications

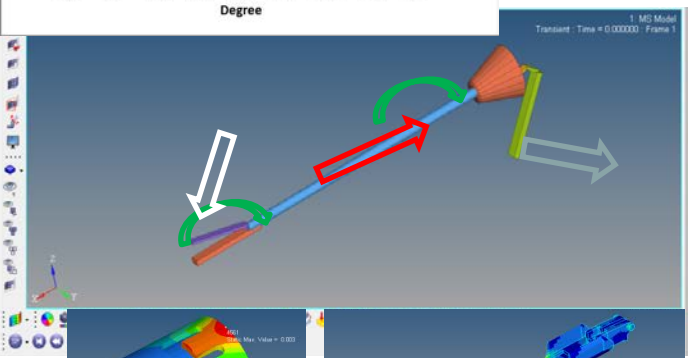
Virtual Prototyping for bioengineering applications

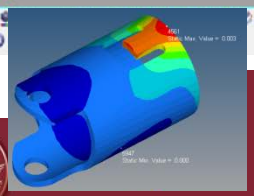
In collaborazione con prof. Franco Marinozzi

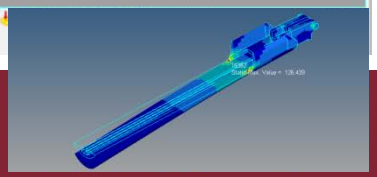
use of bio-engineering models for the implementation of clinical patients' management, for virtual reality tutoring and mentoring and the design of new surgical operating systems and anatomical educational models.

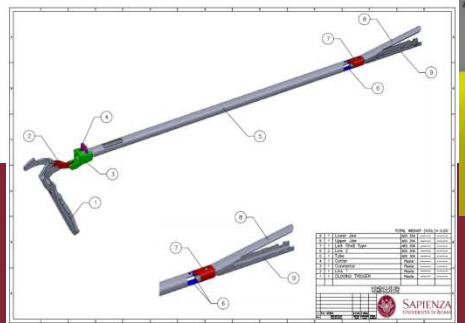
- *Surgical tools optimization and costumization via additive manufacturing*
- *CAE for tool-tissue interaction*
- *Virtual prototyping of surgical operations*
- *Surface reconstruction and data exchange from TAC to CAD/CAE*

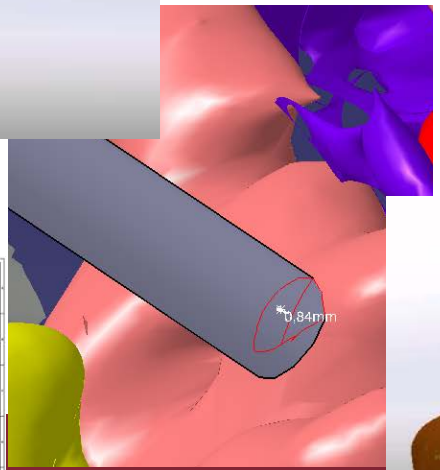












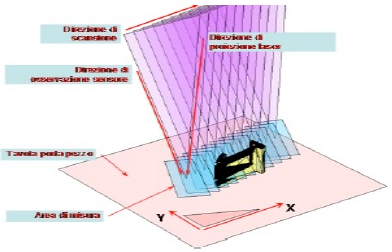
Developed Applications

Computer Aided Tolerance Inspection
PDM for Setting Up Injection Molding Dies

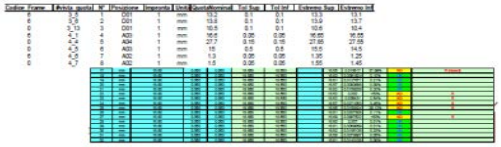
AIM: Automation of tolerance inspection for molding set-up

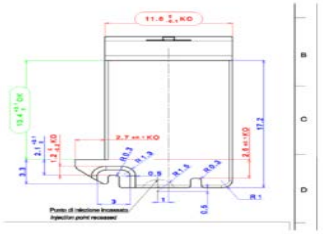
TOOLS: Reverse Engineering via laser scanning, PDM, Image analysis, CAM path

PDM – From 2D drawing to Inspection protocol



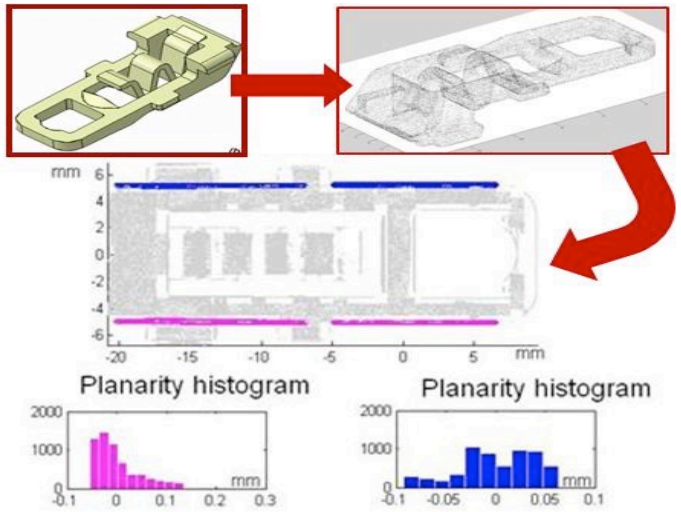
Acquisition Paths

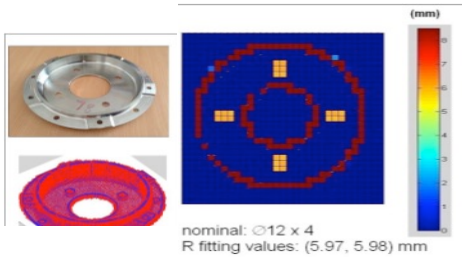




PDM – Inspection Result report in 2D drawing

Reverse Engineering
Computer Based inspection





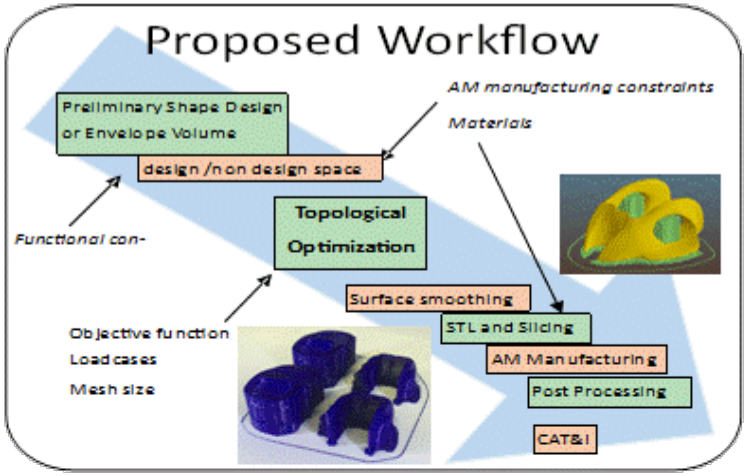
In dettaglio

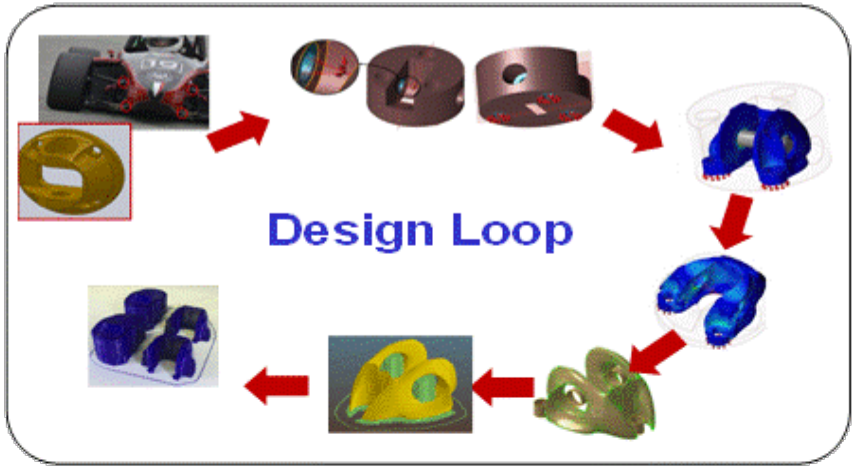
Developed Applications

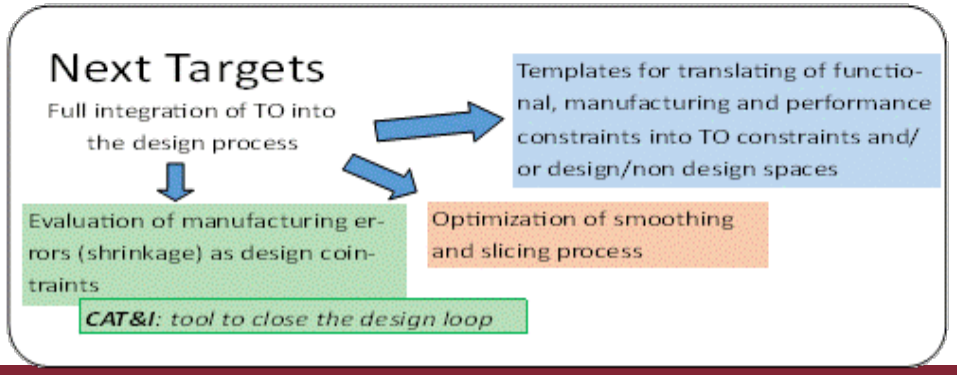
Additive Manufacturing – Topological Optimization

AIM: Topological Optimization as concept design tool, Integration of Design for Additive Manufacturing rules and Topological Optimization

TOOLS: CAD/CAE systems, Surface modeling, Additive Manufacturing







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Grazie per l'attenzione