

Design of Automatic Machinery

Lecturer:

Giovanni Berselli

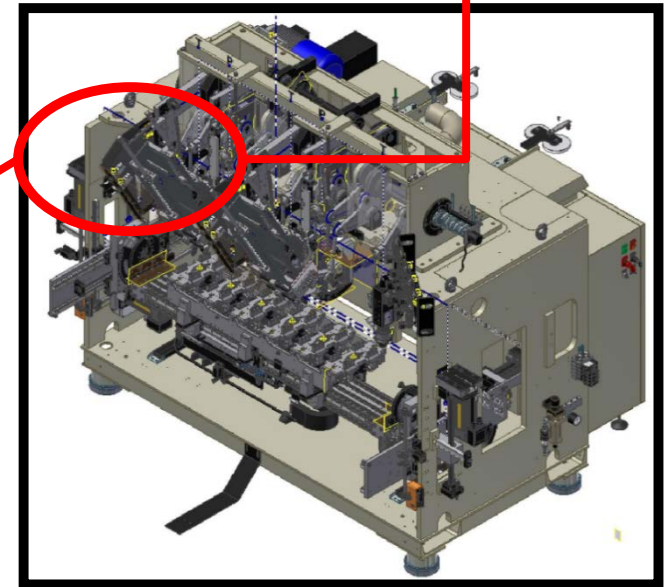
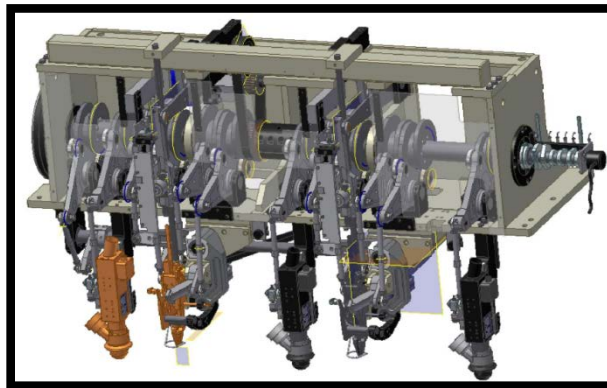
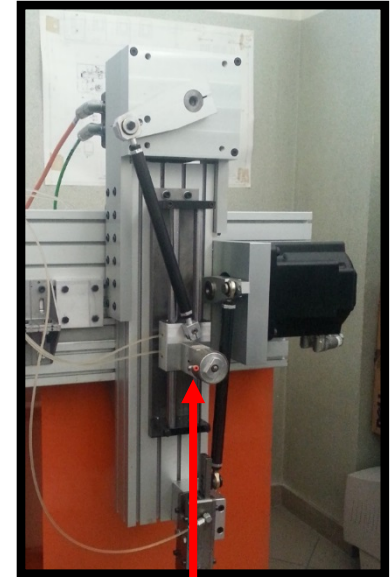
giovanni.berselli@unige.it

DIME Department – Via All’Opera Pia 15/A - Genova



Outline

- **Learning outcomes**
 - Course structure (Theory + Lab.)
 - Didactic material
- **Engineering tools**
 - CAD/CAE for the virtual prototyping of automatic machineries
- **Exam: Project-based learning**
 - Industrial case study

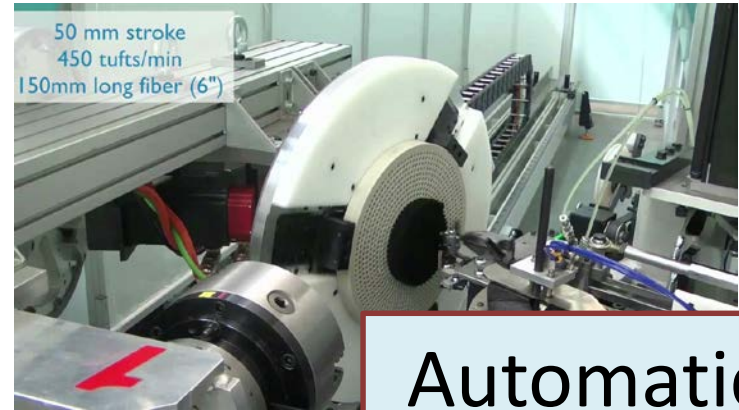
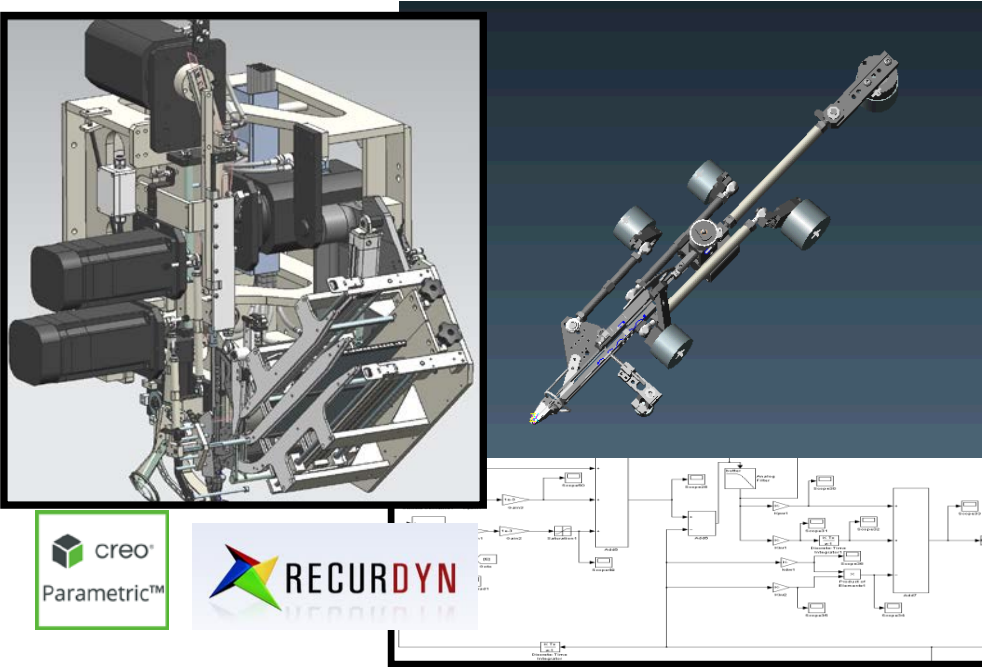


LAB activity: Develop methods and tool for **Virtual Prototyping** of automatic machines

Virtual Prototype



Physical Prototype



Automatic
Machines

- Avoid (when possible) sequential design approaches & **tools which are conceived for particular design problems.**
- **Integrate multi-disciplinary design tools (Also extensive use of the capabilities of commercial software).**

Learning outcomes

“To provide, by means of theoretical concepts and project-based learning, the knowledge of those engineering methods required to develop a project of industrial automation: from functionality identification to the integrated design of both mechanical structure and sensory-actuation subsystem. The course is composed of lectures and lab exercises (by means of a dedicated CAD/CAE software tool)”

- Interdisciplinary knowledge
- **Synthesis, rather than analysis**

Generalities

- Machine architecture
- Functional Structure
- Productive parameters



Continuous Machine



Intermittent Machines

Learning outcomes

“To provide, by means of theoretical concepts and project-based learning, the knowledge of those engineering methods required to develop a project of industrial automation: from functionality identification to the integrated design of both mechanical structure and sensory-actuation subsystem. The course is composed of lectures and lab exercises (by means of a dedicated CAD/CAE software tool)”

- Interdisciplinary knowledge
- **Synthesis, rather than analysis**

Specific Issues

- **Automatic feeding systems** and related selection criteria
- **Actuation system** and related dimensioning



Selection and sizing of the actuation system

Learning outcomes

Essential Info :

- **6 CFU** (50% theory + 50% lab.)
- LAB: SW for integrated design!
- Continuous interaction is welcome ...

Exam: oral exam (3 exercises) + lab. report

- OK for exams upon request (within the limits of UNI rules)
- Possibility to integrate lab project / thesis
- Possibility for thesis abroad

Didactic material:

- **BOOK (under development)** is available
- For advanced CAE: video tutorials are available

Capitolo 7 Attuazione del moto nelle macchine automatiche: aspetti generali

La macchina automatica ed i suoi sottosistemi
In precedenza si erano esaminati schemi organizzativi della MA, atti a mettere in evidenza l'architettura funzionale dal punto di vista delle operazioni sul prodotto. Questo di natura ingegneristica delle trasformazioni, sulla base della trasformazione e della disposizione dei mezzi operativi, dei sistemi di trattamento prodotti, dei mezzi ausiliari di alimentazione dei flussi energetici.

Ora è necessario esaminare la macchina in maniera unitaria, comprendendo i sottosistemi eroganti dal punto di vista della trasformazione e distribuzione di energia (sistemi di attuazione), e della generazione, elaborazione e distribuzione delle informazioni (sistemi sensoriali e unità di governo).

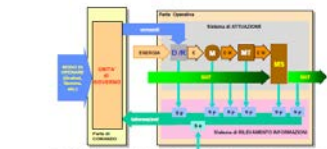


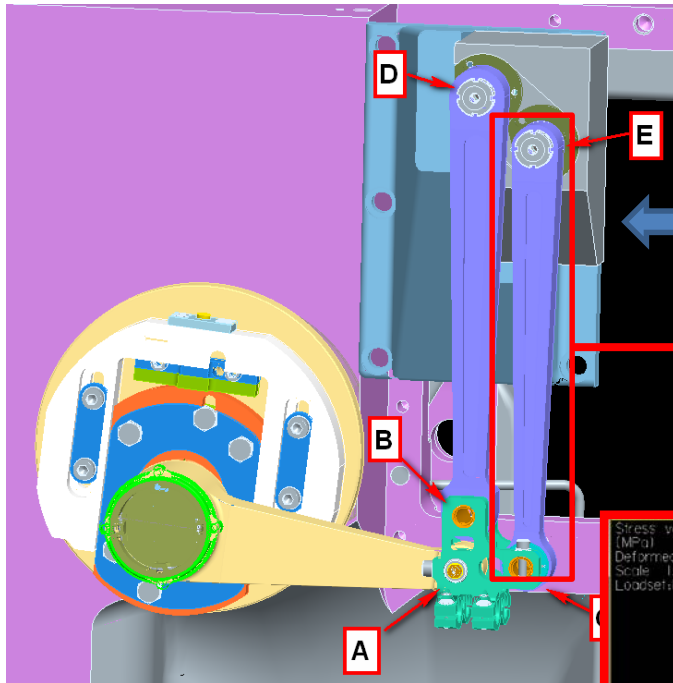
Figura 7.1 Schema generico della struttura di una macchina automatica in relazione ai sottosistemi

Con riferimento allo schema di Figura 7.1, il sistema di attuazione è quello del flusso energetico proprio ed ha lo scopo di generare entro la macchina automatica tutti i vari movimenti richiesti dai mezzi operativi. Specifico MA è il flusso energetico proprio che viene inglobato nel circuito di organi e di nodi, indicati come blocco CDR che semplicemente modula il flusso energetico senza modificarne la natura. Il flusso energetico in uscita dal CDR raggiunge i blocchi M (motori, attuatori, attuatori) entro cui avviene la trasformazione della energia elettrica in energia meccanica del tipo di scelta e necessario. Il flusso energetico viene dai blocchi M poi viene integrato al segnale nei suoi parametri caratterizzanti e quindi può essere in grado di dipendere UT (movimenti, ad es. risultati di velocità, posizioni e variazioni di movimento).

Di ogni CDR di regolazione/distribuzione del flusso energetico agli attuatori operano sotto l'azione di un opportuno flusso di informazioni, generalmente indicati come sensori. La natura e la considerazione di tali sensori determinano le caratteristiche e la considerazione dei movimenti generali.

Software tools:

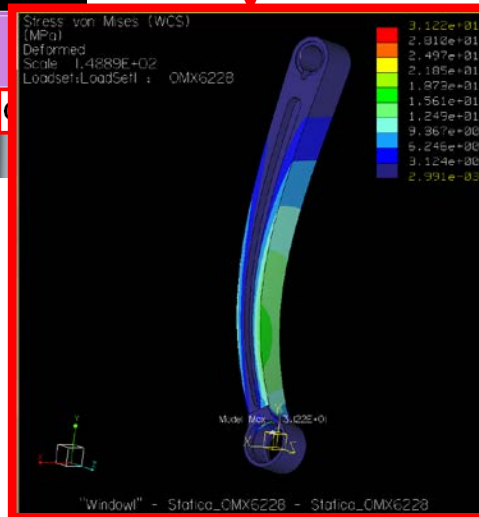
Virtual prototyping tools



CAD/CAE for integrated design

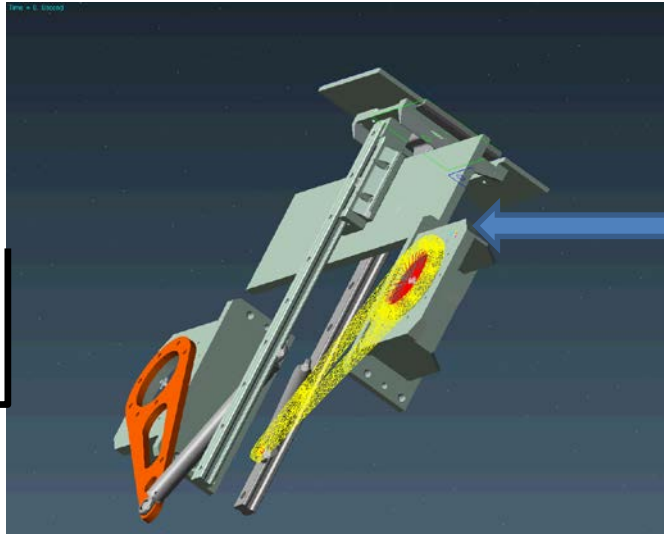
PTC CREO

1. Kineto-Dynamic Analysis/Optimization
2. Structural design
3. Sizing of the actuation system



Software tools:

Virtual prototyping tools

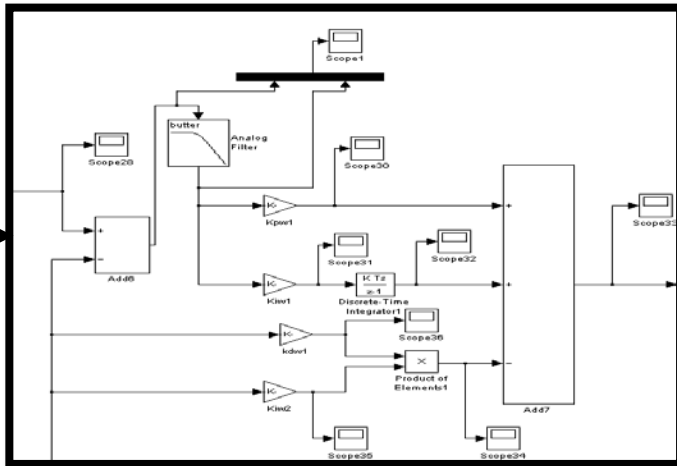


CAD/CAE for integrated design

RecurDyn

<http://www.functionbay.org/>

1. Most advanced Simulation tool for computing motion of complex systems
2. Simulates flexible bodies during motion
3. Embedded structural design/optimization during motion
4. Simulates the actuation and control system (via Matlab integration)



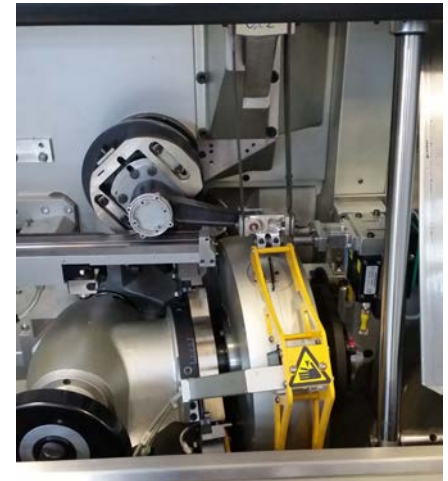
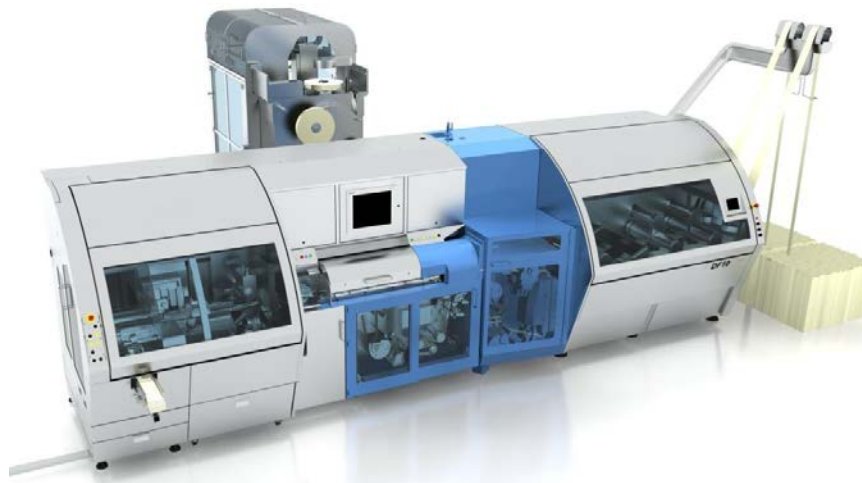
Project-based learning

“CASE study taken from industry”

- Design of a sub-group of an automatic machine for packaging
- Solved via CAD/CAE tools, exactly as done in industry

WE WILL START WITH A SEMINAR FROM THE TECHNICAL
DIRECTOR OF A MAJOR COMPANY

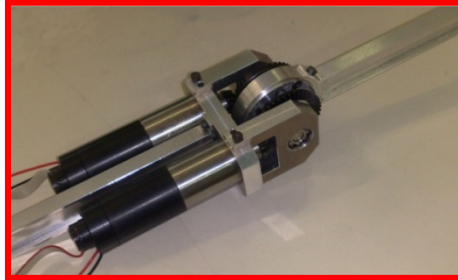
Speaker: Ing. Fulvio Pastore
G.D Spa - www.gidi.it



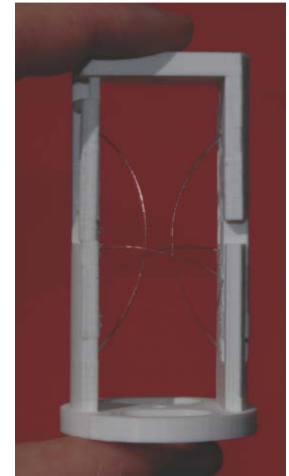
Possibilities for Master Thesis

Applied research @ Uni Genova or Abroad

- **Integrated Design of Compliant Mechanisms.**



- **Integrated Design of NON-conventional Actuation Systems.**



Master Thesis in Medical Robotics



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