



Computer Vision and Multimedia Lab

Department of Electrical, Computer and Biomedical Engineering
University of Pavia



It has been active since the early 70s. The group's initial research activities concentrated on **image enhancement and restoration techniques**; since the early 80s a new stream of research has been actively followed in the field of **parallel architectures for vision and image processing**, and then skills in *high-level image processing domains*, such as scene segmentation and shape characterization and the management of knowledge description and learning capabilities for vision tasks, has been developed.

Recently new research areas have been activated on:

- **Eye Tracking**
- **Digital Humanities**
- **Deep Learning**
- **Proteomics**
- **Social Media Analysis and Mobile Mapping**

ADDRESS

Computer Vision and Multimedia Lab - CVML
Department of Electrical, Computer and Biomedical
Engineering
University of Pavia
Via A. Ferrata 5 - 27100 Pavia, ITALY

Tel: +39 0382 985372/985486 - Fax: +39 0382 422583

Email: web-vision@unipv.it – Website: vision.unipv.it

STAFF

- Director – Luca Lombardi
- Emeritus Professor – Virginio Cantoni
- Associate professors – Luca Lombardi, Marco Porta
- Researchers – Mauro Mosconi, Mirto Musci
- Technician – Alessandra Setti
- Contract professors – Roberto Marmo, Marco Piastra
- Post-doc researcher – Piercarlo Dondi
- PhD student – Gianluca Gerard

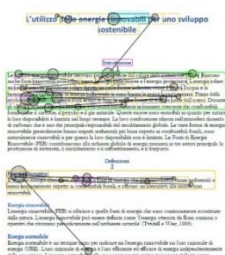
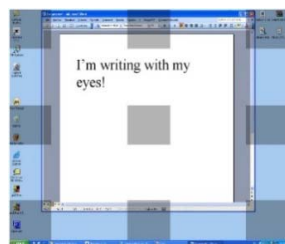


Eye Tracking

Explicit and Implicit Gaze-Based Communication

Info: marco.porta@unipv.it

An **eye tracker** is a device for measuring eye positions and eye movement



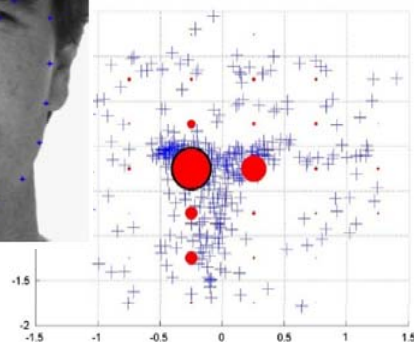
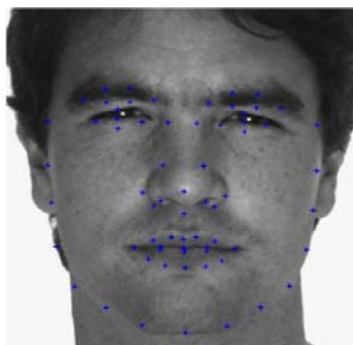
Gaze Input

Using eye tracking as an assistive technology or as an additional input channel (besides keyboard, mouse, etc.)



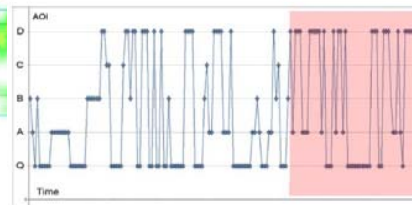
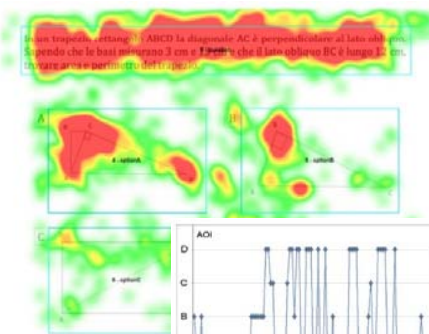
Soft Biometrics

Identifying or verifying the identity of people from the way they look at specific stimuli (e.g., faces)



E-Learning

Understanding learners' behavior and detecting possible comprehension problems



Automotive

Studying the driver's performance through cheap eye tracking solutions



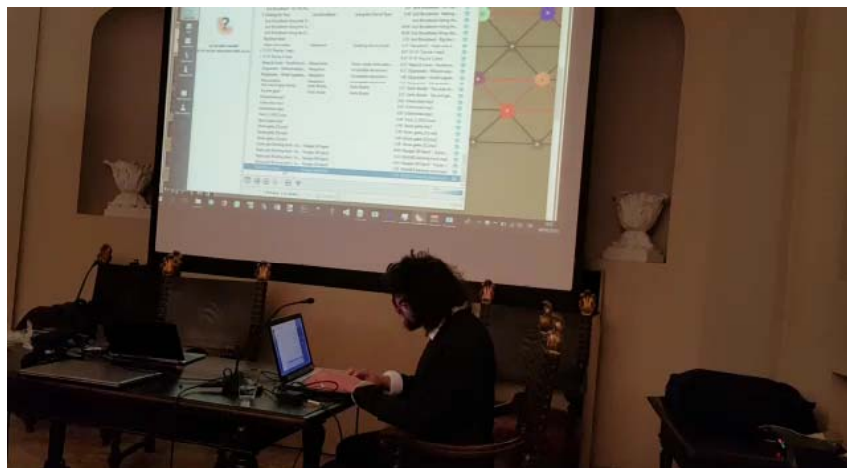
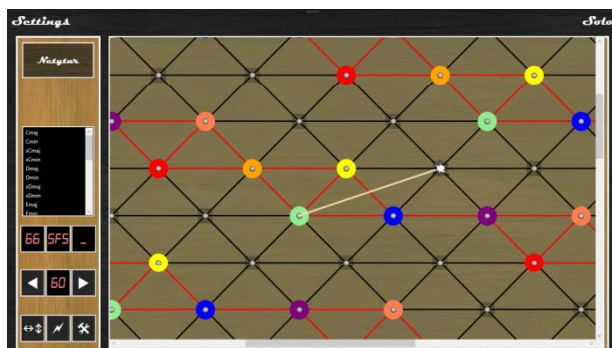
Eye Tracking

Assistive and Persuasive Technologies

Info: mauro.mosconi@unipv.it

Assistive Technologies

Graphical Interfaces for
Eye-Controlled Musical Instruments



Persuasive Technologies

are designed to change attitudes or behaviors of the users through persuasion(*)

E.g., an electronic book to encourage children to read: with the eye-tracking it detects if the user has read a part of text and rewards him/her with special effects, at the right time



(*) three «basic ways that people view or respond to computing technologies (B.J. Fogg): - 1. increase people's ability to perform a target behavior by making it easier (*tools*) - 2. create persuasive experiences that support rehearsing a behavior, empathizing, or exploring causal relationships (*media*) - 3. apply ... social influence (*social actors*)»

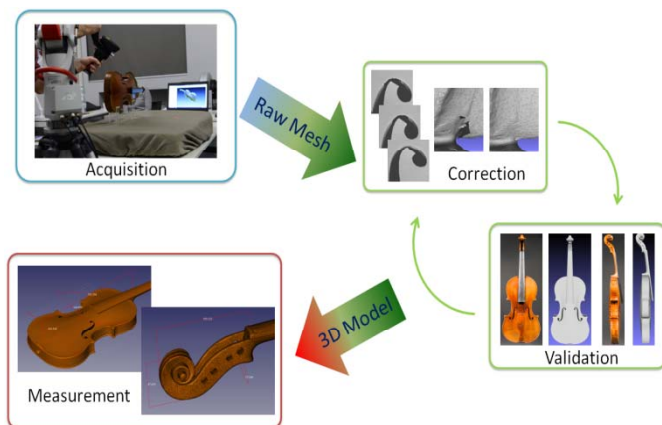


Digital Humanities

Image processing and 3D models of historical instruments

Info: piercarlo.dondi@unipv.it, luca.lombardi@unipv.it

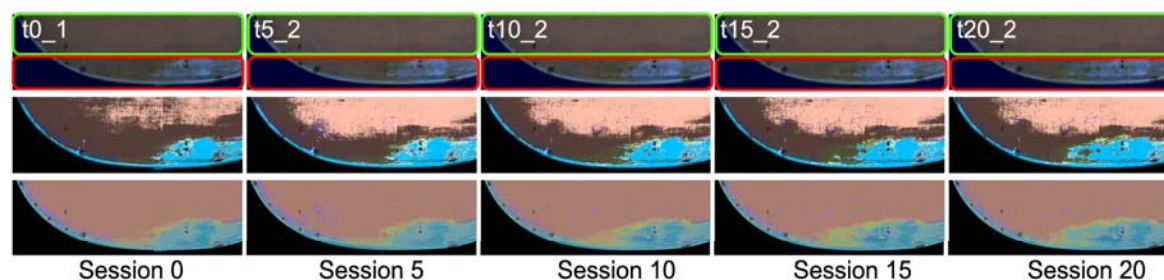
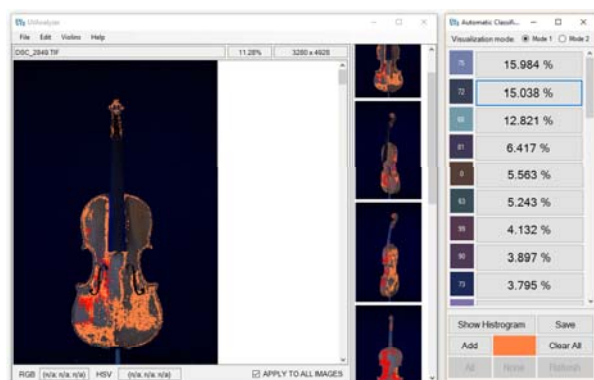
3D scan and 3D modeling



Augmented Reality and Interactive Applications for museums



Analysis of visible and UV induced fluorescence UV (UVIF) images





Digital Humanities

3D for dissemination, promotion, and accessibility of artistic heritage

Info: virginio.cantoni@unipv.it

Tactile Images
for art accessibility



Augmented Reality
E.g., the city of Pavia in
the Renaissance



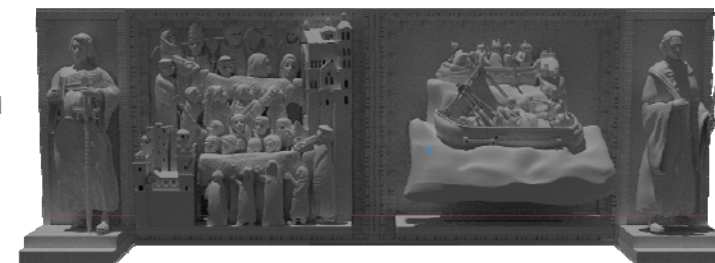
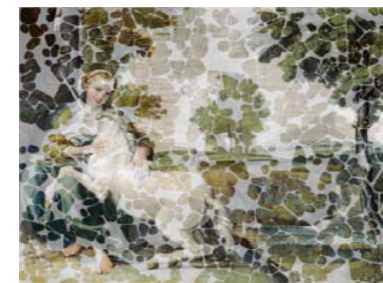
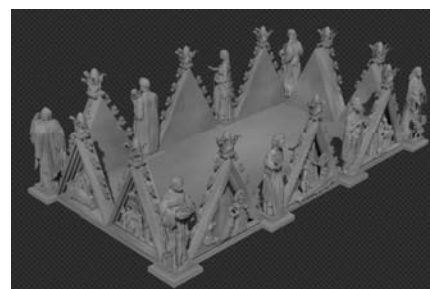
Digital Heritage

Experiential learning

Anastylosis

3D Modeling

E.g., a Certosa portal bas-relief,
the Ark of St. Augustine





Deep Learning

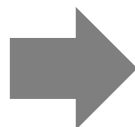
Deep Reinforcement Learning for Collaborative Robotics

Info: marco.piastra@unipv.it

Virtualization of a real-world robot



3D mesh

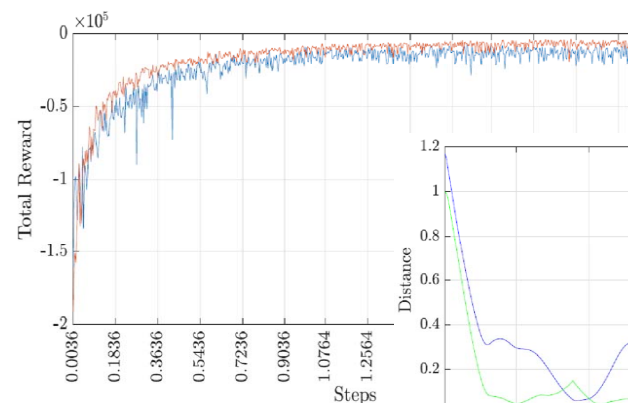
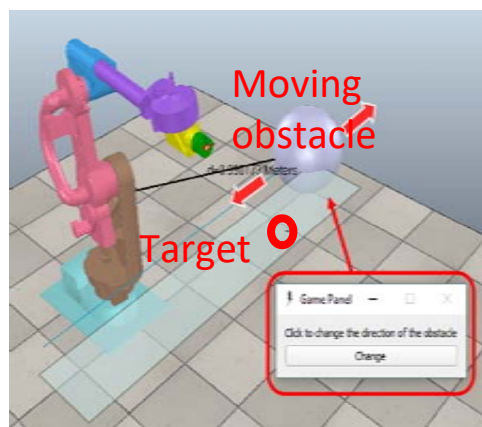


Movable parts

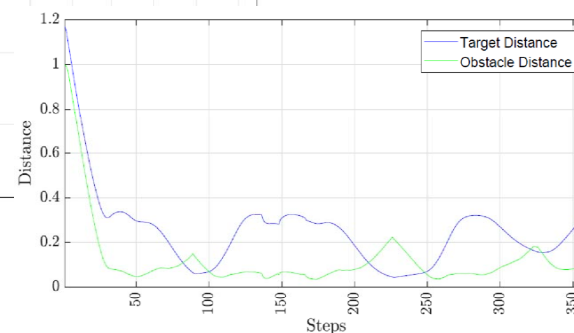


Joints and direct kinematic chain

Learning to reach a target while avoiding obstacles in a simulation environment



Incremental autonomous learning
Experience transfer



Robust avoidance
strategy





Deep Learning

Fall detection with recurrent neural networks

Info: mirto.musci@unipv.it, marco.piastra@unipv.it

Accidental falls: an enormous human cost, especially for elderly people. Need for automatic fall detection techniques for timely warnings. Use of “smart” wearable devices.

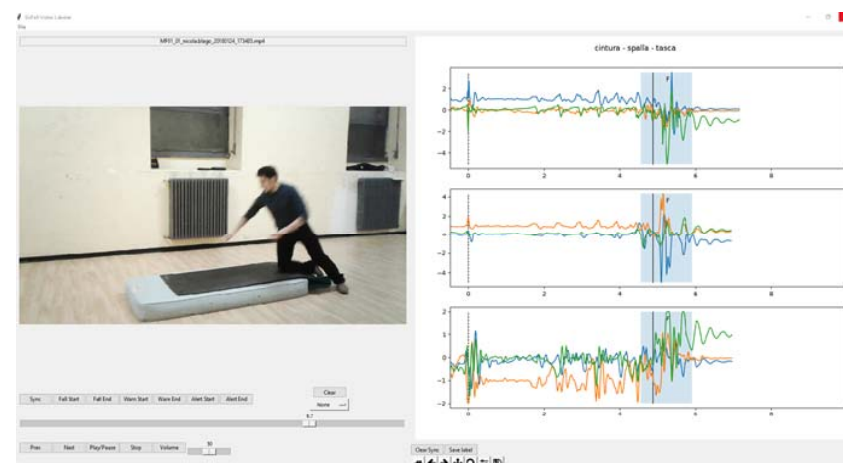
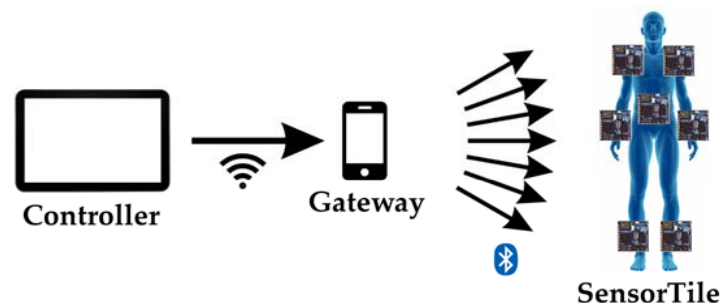


Innovative technique: deep learning on embedded. Implementation challenge: limited computing and memory resources; battery life for continuous use 24x7.



Collection of datasets with simulated falls by volunteers.

Seven carry positions, 17 different activities, 40 volunteers, over 5000 tracks. Manual annotations on videos, basic for training.





Deep Learning

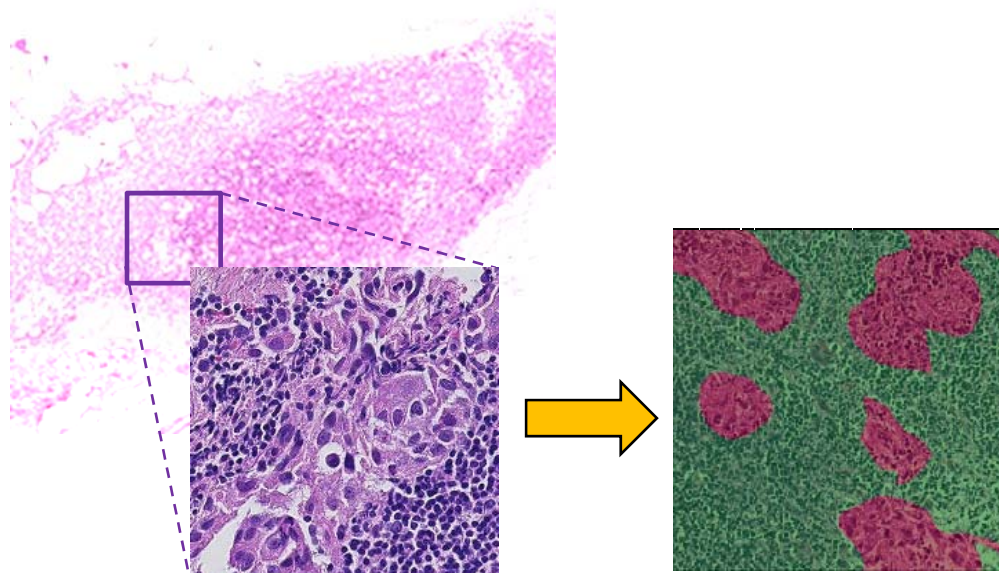
For the diagnosis of breast cancer metastases in lymph nodes
Info: gianluca.gerard01@universitadipavia.it, marco.piastra@unipv.it

Breast cancer is the most common form of cancer among Italian women

- Diagnosis is usually made through a visual analysis of slides containing sentinel lymph node biopsy

The laboratory is currently carrying out a research project that uses the most modern **Deep Learning** techniques for the automatic screening of digital slides

**Automatic
segmentation of
injuries**



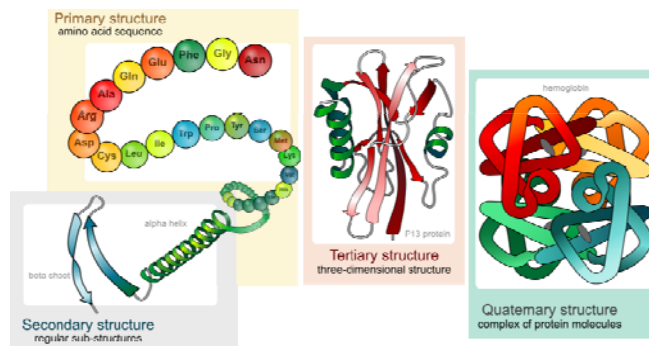


Proteomics

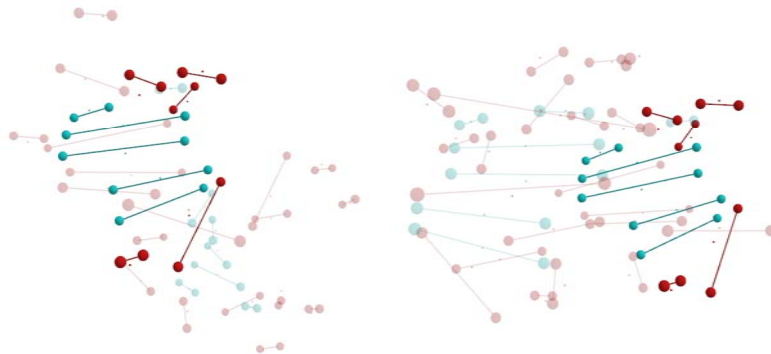
Geometrical motif extraction in the secondary structure of proteins

Info: virginio.cantoni@unipv.it, mirto.musci@unipv.it

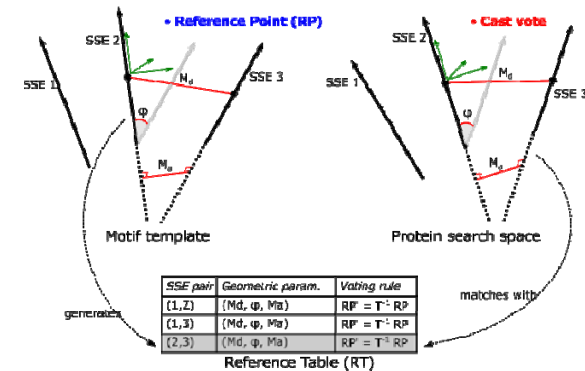
Protein structure defines its biological behavior.
We work at second level to identify recurrent motifs.



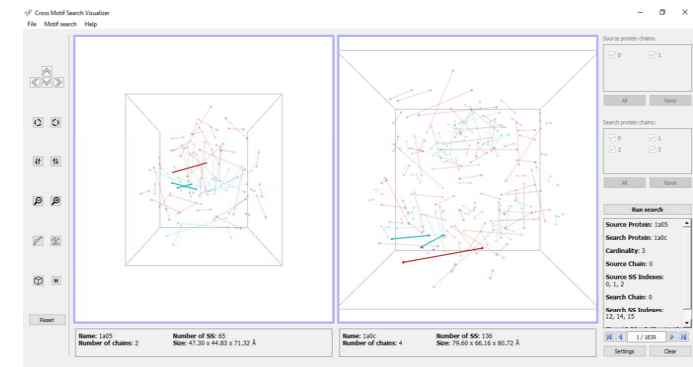
We view proteins as a cloud of segments, we expect *big data*. Goal: discover new motifs with an innovative geometrical method.



Using Hough Transform we developed the Cross Motif Search algorithm with MP and MPI for parallelism.



Motif Visualizer: Open Source OpenGL GUI to improve usability collaboration and validation with biologists.





Social Media Analysis and Mobile Mapping

Info: roberto.marmo@unipv.it

- Network analysis
- Visual recognition of objects
- Analysis and in-depth analysis
- Social commerce
- Customer segmentation
- Malware detection
- Social Media Mining
- Sentiment analysis, opinion mining



High-precision 3D mobile measuring system mounted on vehicle:

- Recognition of road and railway signs
- Tunnel inspection
- Intelligent vehicle
- Laser scanner
- Georeferenced images

