

Introduction

Statistical Laboratory

Alessandro Ortis, PhD

Dipartimento di Matematica e Informatica

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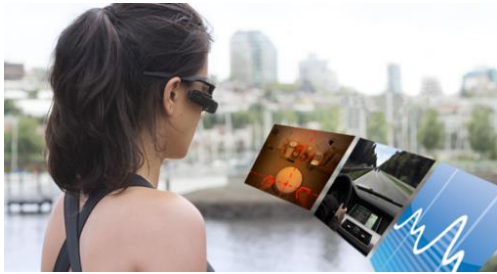
<http://www.dmi.unict.it/ortis/>



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IPlab@UNICT



3 FULL PROFESSORS
2 ASSOCIATE
PROFESSORS
5 RESEARCHERS
4 POST DOCS
>10 PHD STUDENTS

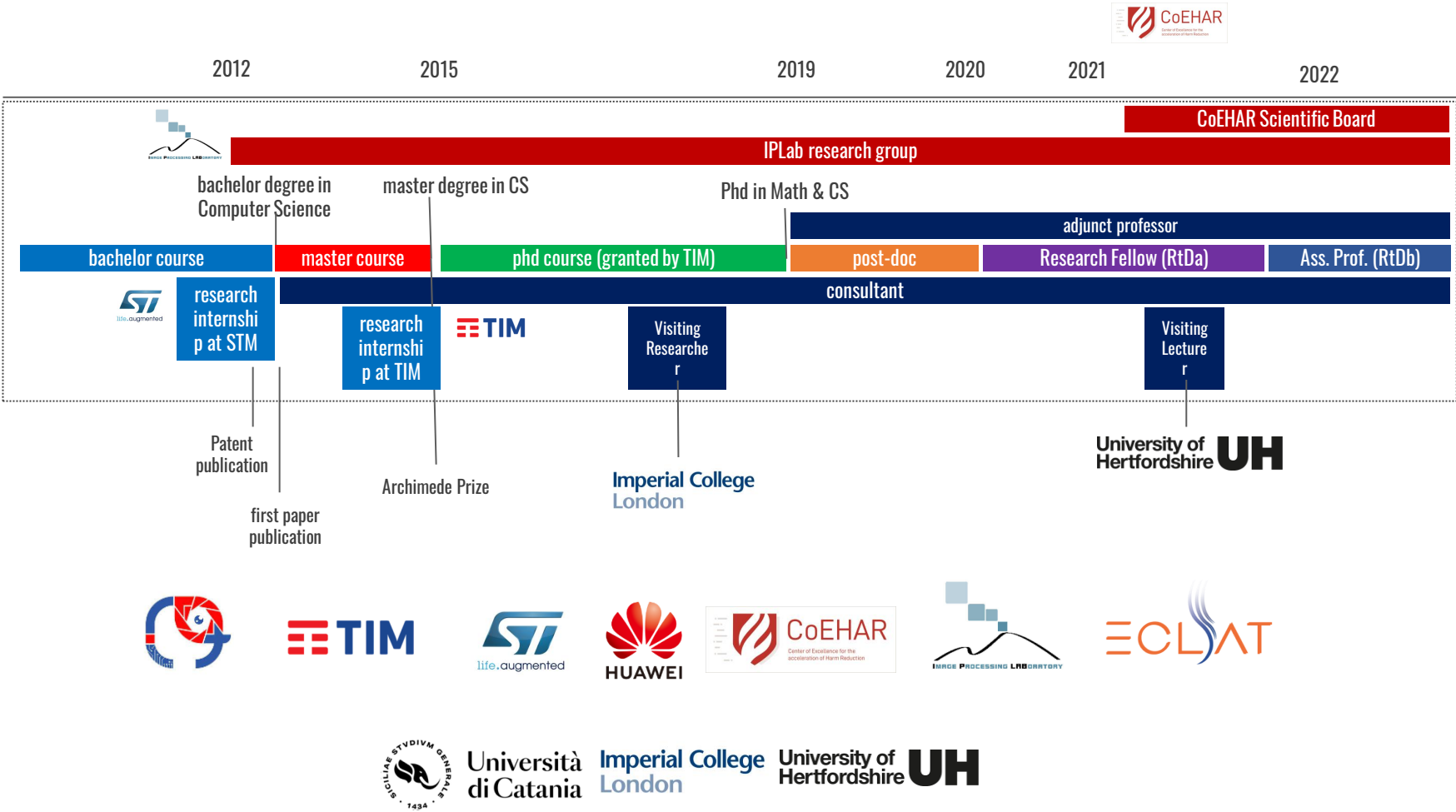
Core Competences: **Computer Vision and Multimedia**

Overall Team (~20 – Lead by Prof. Sebastiano Battiato)

- **Results:** >30 patents, >400 papers
- **Applications to:**
 - Multimedia Forensics and Security
 - EgoCentric Vision
 - Cultural Heritage
 - Social Media Mining
- **R&D projects:**
 - STM (Catania, Grenoble): Joint R&D lab (since 2007), Ph.D. (>10), grants (>10)
 - Funded projects: ENIAC (1), PO/FESR (4), MISE HZ2020(1), other (4)
- **International Events:** ICVSS (since 2007), MISS (since 2014) ICIAP 2017, ACIVS 2015, VISAPP



About me – Career overview



About me – Ongoing research projects

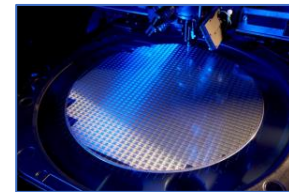
ADAS+ - Sviluppo di Tecnologie e Sistemi Avanzati per la Sicurezza dell'Auto mediante piattaforme Advanced Driver Assistance System - PON Ricerca e Innovazione 2014-2020.

SATURN - Smart mAnufacturIng - Progetto MISE PON Fabbrica Intelligente.

SALIRE - Sound Algorithms for Low-latency Intelligent Recognition of Event - PO FESR SICILIA 2014-2020 - Azione 1.1.5.

ARTES 5.0 Advanced Robotics and enabling digital TEchnologies & systems 5.0 – RESTART ITALY - EU Call DIGITAL-2021-EDIH-01

Industrial



Health



Food Recognition Technology (*Principal Investigator*) – CoEHAR - founded by the Foundation for a Smoke-Free World

MAMI-MED - La coorte Mamma&Bambino: un approccio Multisetoriale Alla salute Materno-Infantile Mediante valutazione dell'Esposoma nelle Donne - Piano di incentivi per la ricerca di Ateneo 2020/2022 (Pia.ce.ri).

EPIRADIOCLINF - Impatto di caratteristiche epidemiologiche, radiologiche, cliniche e molecolari nella diagnosi e nel management delle polmoniti COVID-19 – EPIRADIOCLINF: un approccio di studio integrato.

DL4HEALTH – Deep Learning for Health- PO FESR SICILIA 2014-2020 - Azione 1.1.5.

"In Silico World: Lowering barriers to ubiquitous adoption of In Silico Trials - ISW" HORIZON2020

Collaborations

TIM Telecom Italia – AI for Smart Spaces (2018, 2020, 2021, 2022)

HUAWEI - Image Acquisition Pipeline (2022)

My research

Areas: Computer Vision – Image Processing – Machine Learning

**I – Multimedia
Sentiment Analysis**

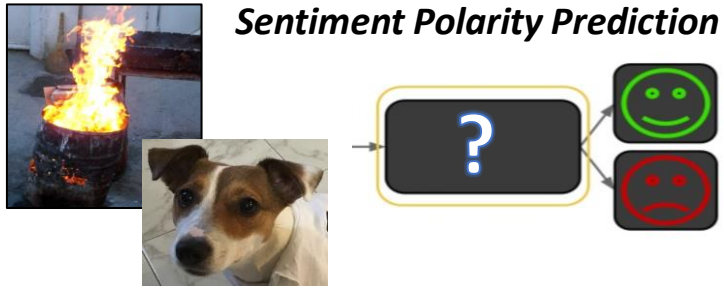
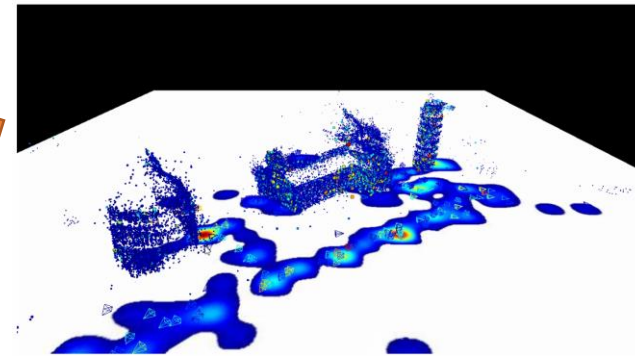
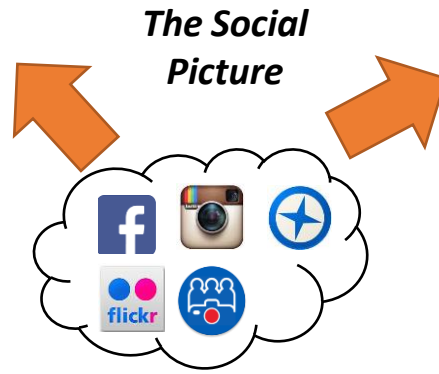
**II – Image
compression**

III – Industrial

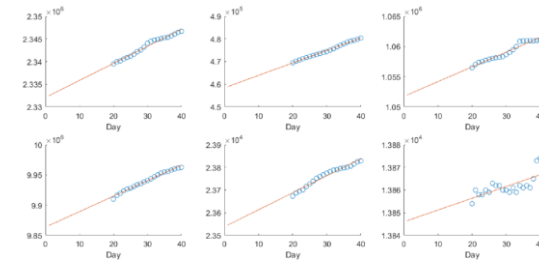
**IV – Physiological
Signal Analysis**

V – Health

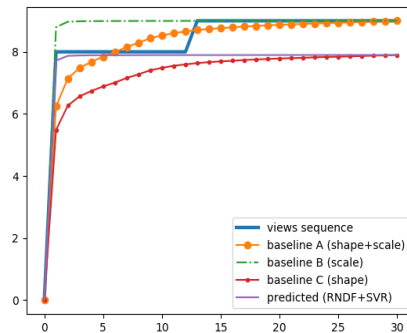
I – Multimedia Sentiment Analysis



Social Advertising Assessment

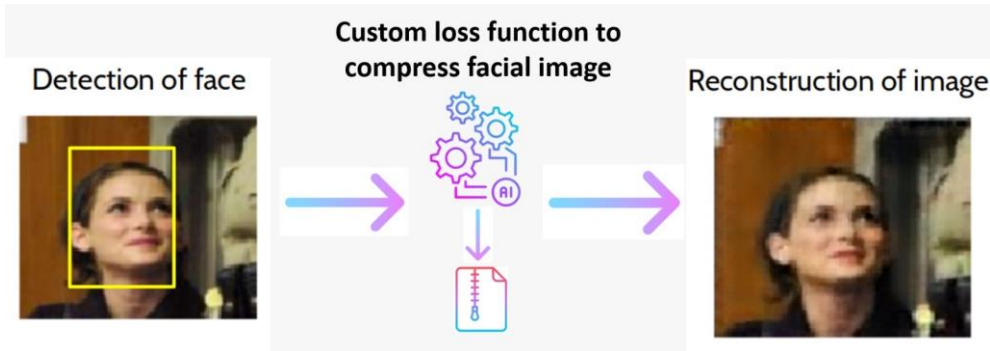
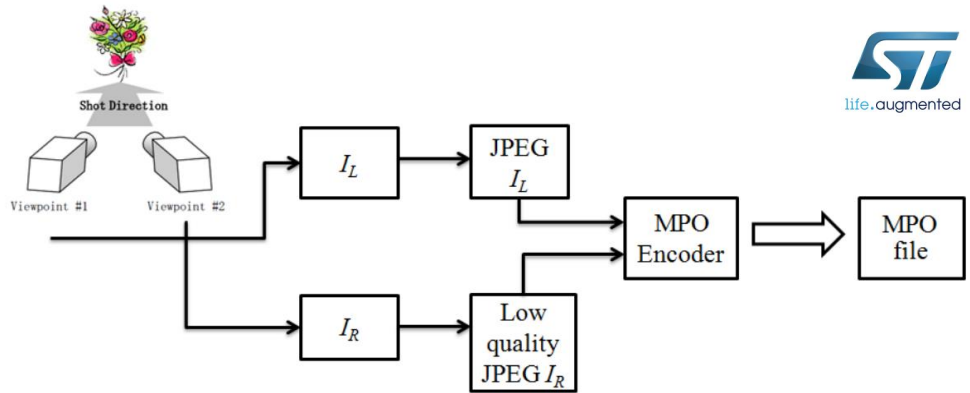


Popularity Dynamic Prediction



II – Image Compression

Stereoscopic Image Compression



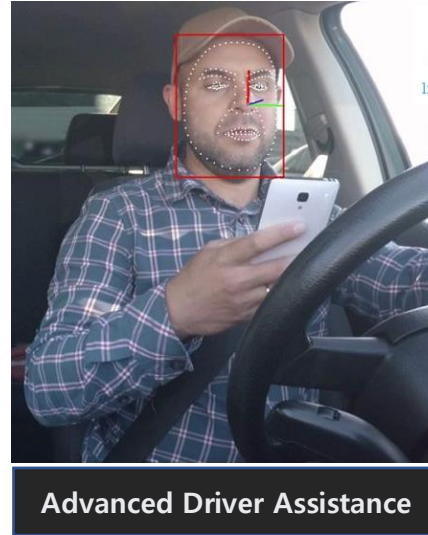
Compression for Face Images

III – Industrial (a)

MBZIRC Competition

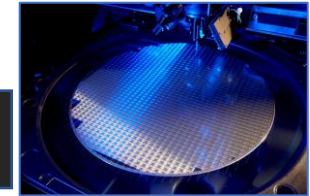


ADAS+



SATURN

Smart
Manufacturing



SALIRE

Sound Analysis for Event Recognition

Events

MBZIRC 2017 Challenge – fourth ranked team.

Proceedings

*Battiato, et al. (2020). **Benchmarking of Computer Vision Algorithms for Driver Monitoring on Automotive-grade Devices.** In *AEIT International Conference of Electrical and Electronic Technologies for Automotive (AEIT AUTOMOTIVE)* (pp. 1-6). IEEE.*

*S. Battiato, et al. (2017). **A System for Autonomous Landing of a UAV on a Moving Vehicle.** In *Proceeding of International Conference on Image Analysis and Processing. ICIAP. LNCS Vol. 10484, Springer, Cham, 2017.**

*Cantelli, et al. (2017). **Autonomous Landing of a UAV on a Moving Vehicle for the MBZIRC.** *Proceeding of The 20th International Conference on Climbing and Walking Robots and Support Technologies for Mobile Machines, 2017 (p. 197).**

III – Industrial (b)

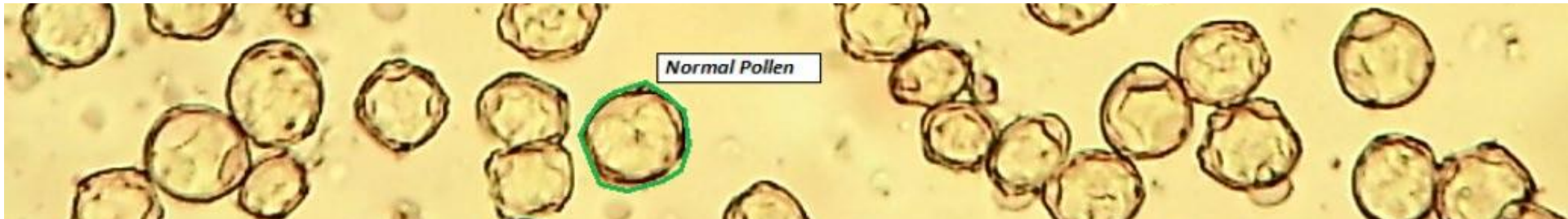
Pollen Image Analysis



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- Proceedings** Trenta F., Ortis A., Battiato S. (2021) **Fine-Grained Image Classification for Pollen Grain Microscope Images**. In *Computer Analysis of Images and Patterns. CAIP 2021. Lecture Notes in Computer Science*, vol 13052. Springer.
- Battiato S. et al. (2021) **Pollen Grain Classification Challenge 2020**. In: Del Bimbo A. et al. (eds) *Pattern Recognition. ICPR International Workshops and Challenges. ICPR 2021. Lecture Notes in Computer Science*, vol 12668. Springer.
- Battiato, S., Ortis, A., Trenta, F., Ascari, L., Politi, M., Siniscalco, C. (2020). **Detection and Classification of Pollen Grain Microscope Images**. *CVPR Workshop on Computer Vision for Microscopy Image Analysis (CVMI)*.
- Battiato, S., Ortis, A., Trenta, F., Ascari, L., Politi, M., Siniscalco, C. (2020). **Pollen13K: A Large Scale Microscope Pollen Grain Image Dataset**. *IEEE International Conference on Image Processing (ICIP)*.
- Challenge Session – **Pollen Grain Classification Challenge** - *IAPR International Conference on Pattern Recognition (ICPR 2020)*

**Organizer
Activity**

III – Industrial (c)

AI for Smart Environments (conto terzi)



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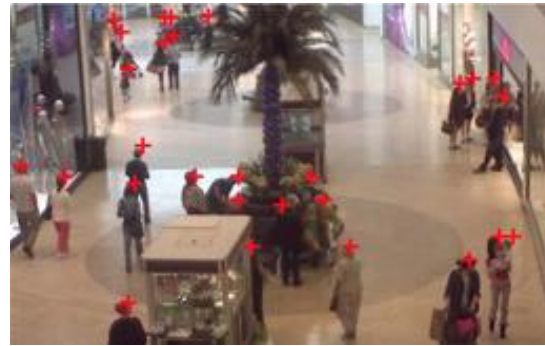
Trash Detection



Social Distancing



People Counting



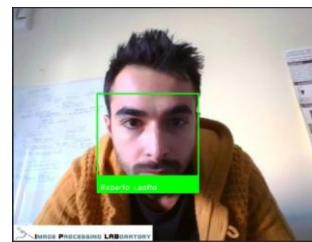
Sound Recognition

Rank	Label	Confidence
1	Siren	<div style="width: 100%;"></div>
2	Emergency vehic	<div style="width: 100%;"></div>
3	Police car (sir	<div style="width: 100%;"></div>

Anomaly Detection



Face Recognition

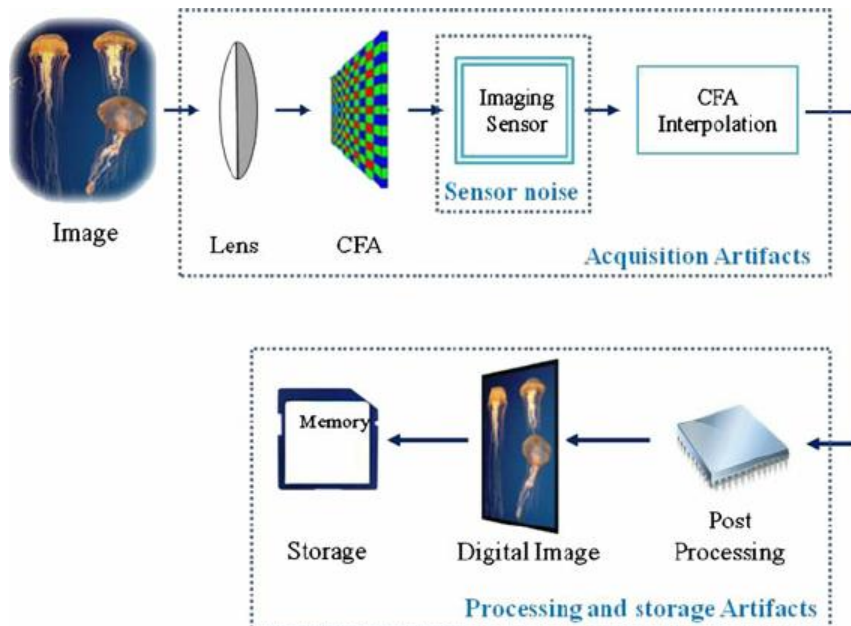


III – Industrial (d)

Image Acquisition Pipeline



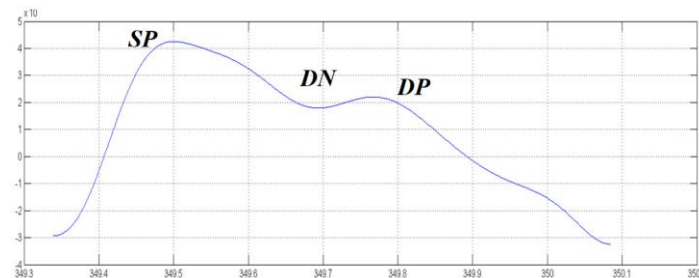
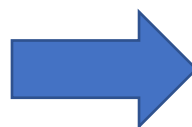
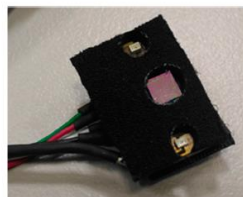
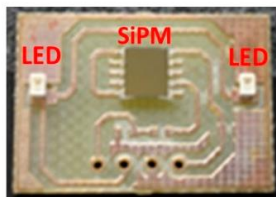
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Grenoble Sensor Application Lab



IV – Physiological Signal Analysis



Journals

Rundo, F., Ortis, A., Battiato, S., Conoci, S. **Advanced Bio-Inspired System for Noninvasive Cuff-Less Blood Pressure Estimation from Physiological Signal Analysis.** *MDPI Computation* 6.3 (2018): 46.

Rundo, Francesco, Conoci, Sabrina, Ortis, Alessandro, Battiato, Sebastiano (2018). **An advanced bio-inspired photoplethysmography (PPG) and ECG pattern recognition system for medical assessment.** *MDPI SENSORS*, vol. 18.

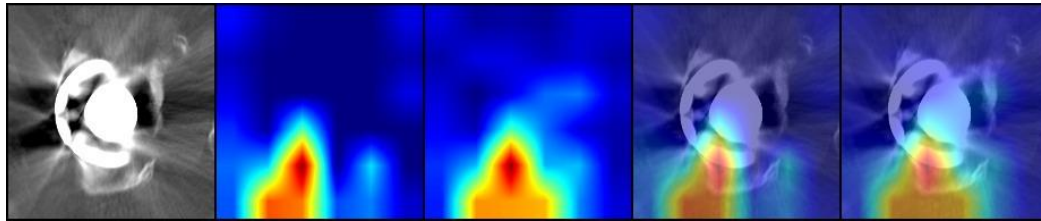
Proceedings

Rundo, F.; Ortis, A.; Battiato, S. and Conoci, S. (2019). **Advanced Multi-neural System for Cuff-less Blood Pressure Estimation through Nonlinear HC-features.** In *Proceedings of the 16th International Joint Conference on e-Business and Telecommunications - Volume 1: SIGMAP*, ISBN 978-989-758-378-0, pages 321-325. DOI: 10.5220/0007909403210325

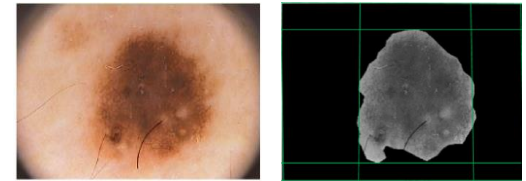
IV – Health (a)



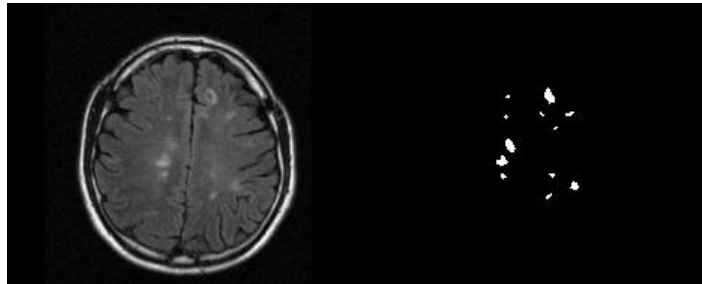
Articular Prosthesis Infection



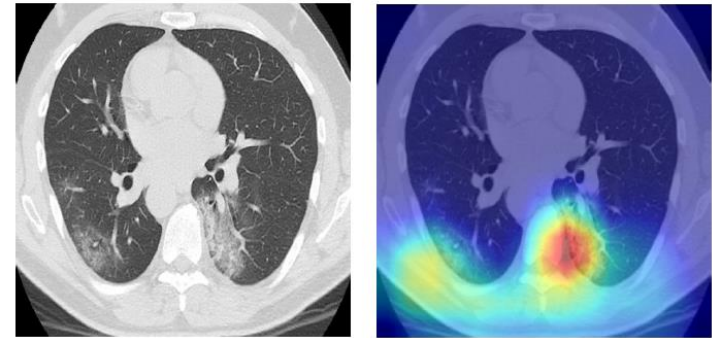
Melanoma Classification



MRI for Multiple Sclerosis Analysis



Covid-19 Infection Percentage



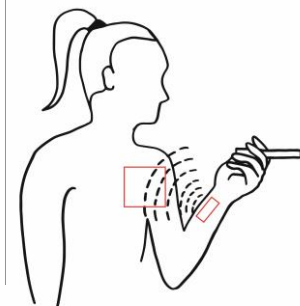
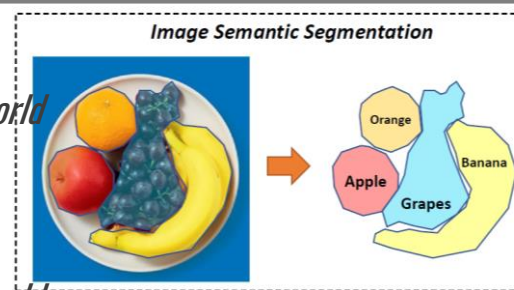
Tobacco Harm Reduction

Food Recognition Technology (Principal Investigator)

CoEHAR project funded by the Foundation for a Smoke-Free World

SenseQuit: A novel smart smoking monitoring system

CoEHAR project funded by the Foundation for a Smoke-Free World



Journals

Ortis A, Caponnetto P, Polosa R, Urso S, Battiato S. **A Report on Smoking Detection and Quitting Technologies.** *International Journal of Environmental Research and Public Health.* 2020; 17(7):2614. Digital Health Section.

Allegra, D., Battiato, S., Ortis, A., Urso, S., Polosa, R. (2020). **A Review on Food Recognition Technology for Health Applications.** *Health psychology research* 8.3 172-187.

Proceedings

Hussain, M., Ortis, A., Polosa, R., & Battiato, S. (2022). **User-Biased Food Recognition for Health Monitoring.** In *International Conference on Image Analysis and Processing* (pp. 98-108). Springer, Cham.

Best Poster
Presentation
Award



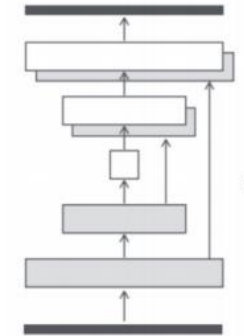
Battiato S., Caponnetto P., Giudice O., Hussain M., Leotta R., Ortis A. and Polosa R. (2021). **Food Recognition for Dietary Monitoring during Smoke Quitting.** In *Proceedings of the International Conference on Image Processing and Vision Engineering - Volume 1: IMPROVE*, ISBN 978-989-758-511-1, pages 160-165.

Ongoing research (new lines)

- Deepfakes creation and detection
- Adversarial Machine Learning



Synthesized Image



U-Net



Target video image with drawn keypoints

Proceeding

Cauli, N., Ortis, A., & Battiato, S. (2022). **Fooling a Face Recognition System with a Marker-Free Label-Consistent Backdoor Attack**. In *International Conference on Image Analysis and Processing* (pp. 176-185). Springer, Cham.

Scientific Events

IAPR *International Conference on Image Analysis and Processing (ICIAP 2021)*
Deepfake Images Detection and Reconstruction Challenge

Invited Speaker - ICIAP 2021 - Tutorial: An Introduction on Deepfakes Creation and Detection Approaches.

Invited speaker - IMPROVE 2022 - Tutorial: Deepfakes and Adversarial Machine Learning.

Invited Guest Lecturer - University of Hertfordshire (UK) – Topics: Artificial Intelligence, GAN, Deepfakes and Adversarial Machine Learning

Coming Soon Projects

**Just Smart - Giustizia Smart: Strumenti e modelli per ottimizzare il lavoro dei giudici
- PON Governance e Capacita' Istituzionale 2014-2020**

**IPER AGRIS - Integrated Process of E-resources & Robotics for precision Agricultural
Systems - MISE Bando Fabbrica Intelligente e Agrifood**

Smart Gate - Health & Security Smart Gate - PO FESR 2014/2020 – Azione 1.1.5



STATISTICAL LABORATORY

1° Year

Learning Objectives

AIMS AND SCOPE

The aim of the course is introduce the knowledge of the R language for statistical data analysis with special focus on descriptive statistics, probability distributions and statistical inference.

Teaching Staff

Alessandro Ortis

Credit Value

3

Laboratories

36 hours

Term / Semester

1°

Course Structure

Lectures and practical activities and data analysis in R.

Prerequisites required

Basics of linear algebra and statistics.

Frequency of Lessons

Mandatory.

LEARNING OBJECTIVES

1. **Knowledge and understanding (Conoscenza e capacità di comprensione).** The objectives aim at introducing the knowledge of the R language for statistical data analysis with special focus on descriptive statistics, probability distributions and statistical inference.
2. **Applying knowledge and understanding (Capacità di applicare conoscenza e comprensione).** On completion. Students will be able to utilize the R language for: *i*) providing basic statistical analyses of data; *ii*) simulating data according to given probability distributions; *iii*) applying main methods of statistical inference.
3. **Making judgements (Autonomia di giudizio).** On completion, students will be able to extract knowledge from data through statistical analyses in R.
4. **Communication skills (Abilità comunicative).** On completion, students will be able how to present the results from the statistical analyses, based on the use of the statistical software R.
5. **Learning skills (Capacità di apprendimento).** On completion, students will be able how to utilize the statistical software R for basic data analysis and modeling.

Detailed Course Content

Use of the statistical software in R regarding:

Descriptive Statistics. Simple Statistical Distributions. Data tables. Frequency distributions. Main summary statistics: arithmetic mean, geometric mean, harmonic mean. Median and percentiles. Variance, standard deviation, relative variation. Graphical representations. Multiple Statistical Distributions. Contingency Tables. Joint distributions, marginal and conditional distributions. Covariance and correlation.

Probability. Random number generation and data modeling according to different probability distributions: uniform, binomial, Poisson, Gaussian.

Statistical inference. Sample distributions: Student-t, chi-square. Confidence estimation. Confidence level. Confidence bounds for means, variances, proportions. Hypothesis testing. Null hypotheses and alternative hypotheses. P-values. Statistical tests for means, variances, proportions, comparison of means, comparison of proportions.

Statistical models. The simple regression model. Goodness of fit. Residual analysis. Inference on the parameters of a linear regression model.

Course planning

Topics	Text references
1 Introduction to R, Basic Commands in R, Indexing Data, Matrices and Lists, Loading Data	Lecture Notes
2 Graphs, Data Types and Structures, Conditional Statements and Loops, Graphs and Data Visualization	Lecture Notes
3 Mean, Median, Variance, standard deviation, quantiles, percentiles, interquartile distance, boxplot, outlier detection	Lecture Notes
4 Functions in R, data filtering	Lecture Notes
5 Bivariate analysis, statistical inference, contingency table, joint probability, marginal probability, chi-squared test, t-test, linear regression.	Lecture Notes

VERIFICATION OF LEARNING

Modality of verification of learning

Practical activity and data analysis with R

Sample Exam Questions

Perform a univariate analysis considering the attribute X

Report the correlation matrix among the attributes considering 2 digits precision

Perform a Linear Regression analysis of the relationship between the two features X and Y with the variable Z. Report below the output of the `summary()` function applied on the linear regression model obtained using `lm()`. Then, comment the results.

Is the dataset balanced with respect to the attribute X?

Visualize the scatter plot considering the variables X and Y. Report below the code used to create the plot.

Info&contacts

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Email: ortis@dmi.unict.it

Personal webpage: <http://www.dmi.unict.it/ortis/>

Old course lectures and notes:

<http://www.dmi.unict.it/ortis/StatsLab/>

Info&contacts

The lessons are based on the following sources:

- An Introduction to Statistical Learning with Applications in R (course book)
- RStudio

