

Computational Data Science group

L. Antonelli, A. Astorino, T. Cappuccio¹, V. De Simone², L. Di Puglia Pugliese, M. Gaudio², M. Giordano, I. Granata, M.R. Guarracino³, L. Maddalena, M. Sammarra
¹research fellow, ²research associate

Goals

Development of **models, algorithms, and software tools** to discover, understand, and model scientific phenomena through the **analysis of data produced in experiments and tests** and/or through the **simulation of the processes that generate them**. This allows us to face new multidisciplinary challenges in the field of ICT

Research Activities

By appropriately integrating the CDS-group methodologies with the knowledge of different application domains, a new and more effective perspective is provided to the analysis of real problems and the interpretation of the results.

Methodologies: computational simulation, modeling, analysis, processing, and management of complex, heterogeneous, and large data sets through high-performance computing and distributed computing

Skills: computer science, applied mathematics, statistics, and computational biology

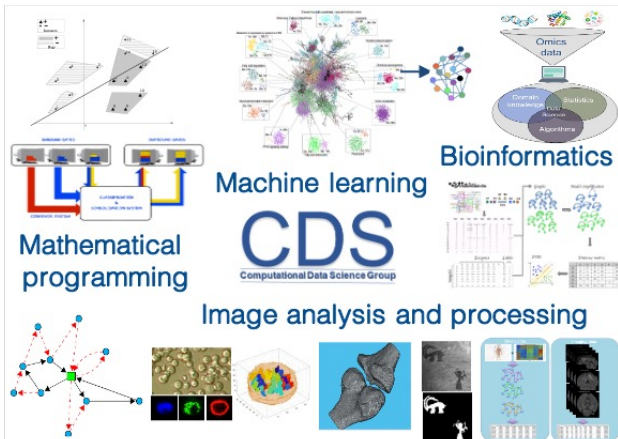
Topics

Mathematical programming and Machine Learning:

- optimization techniques for non-differentiable problems (MIL)
- mathematical models and optimization methods for complex systems (track scheduling, goods distribution via land vehicles and drones, data routing and collection)
- ML methods for optimization algorithms (Variable Neighborhood Search for crowd-shipping, Branch-and-Cut)
- methods for classification and clustering of data in the form of networks (distribution-based representation, simplification, embedding, and adversarial attacks)

Image analysis and processing: methods, algorithms, and high-performance software for processing and quantitative analysis of images and image sequences (segmentation and 3D reconstruction of knee bones from MRI and proteins from fluorescence image stacks; detection, classification, tracking, and recognition of moving objects in sequences; segmentation and analysis of petroglyphs in archeological images)

Bioinformatics: approaches, methodologies, and tools for the interpretation of biological phenomena and the identification of diagnostic, therapeutic, and prognostic biomarkers (network biology, clinical/omics data analysis and integration, "omics imaging")



Application Fields: Logistics, Transportation, Telecommunications, Robotics, Medicine, Biology, Genetics, Archeology

Projects

- **INDAM** (Istituto Nazionale di Alta Matematica "F. Severi") **ICAR-CNR Research Unit** [L. Antonelli, A. Astorino, M. Giordano, I. Granata, M.R. Guarracino, L. Maddalena]
- **PRIN 2022** "Optimizing sustainable multi-modal last-mile distribution with carbon-free autonomous vehicles, ground robots, drones, and public transport", MUR, 10/23-09/25 [L. Di Puglia Pugliese, M. Sammarra]
- **PRIN 2022** "A mathematical approach to inverse problems arising in cultural heritage preservation and dissemination" MUR, 11/23-11/25 [L. Antonelli, V. De Simone, M.R. Guarracino, L. Maddalena]
- **GNCS 2023** "Advanced Models and Methods in Computer Vision" [L. Antonelli]
- Collab. with **MEDIA** – METodiche DIagnostiche ad alta efficienza per il paziente osteoarticolare. Dedicated MRI for pre-operative non-invasive imaging for prosthesis implants, 01/20-06/23 [L. Antonelli, L. Maddalena]
- **CNRBiOmics**, National Research Center in Bioinformatics for Omics Sciences: empowerment of infrastructure human capital, 09/20-12/25 [L. Maddalena, I. Granata]
- **BiBiNet** - Big Biocancer Network. POR FESR Lazio 2014-2020: Analysis of biological networks for marker identification and active molecules repositioning, 01/23-04/23 [I. Granata, M.R. Guarracino]
- **PRIN 2022** "The Asplenia Biobanking Community: from Analytes to theRapEutic decision making (ABCare)" MUR, 10/23-10/25 [I. Granata, M. Giordano]

Collaborations

- CEINGE - Biotecnologie Avanzate
- CNR (IBB, IBPM, ICAR HPCCS-group & SLAS-group, ICB, IEOS, IGB, ISASI)
- Esaote S.p.A.
- Fondazione IDIS - Città della Scienza
- GNCS-INDAM
- Istituto Nazionale Tumori - IRCCS - Fondazione G. Pascale
- National Research Univ. Higher School of Economics (RU)
- Ospedale Policlinico San Martino, Genova
- Sapienza Univ. of Rome
- Univ. Magna Graecia of Catanzaro
- Univ. of Cagliari
- Univ. of Calabria
- Univ. of Campania Luigi Vanvitelli
- Univ. of Cassino and South. Lazio
- Univ. of Florence
- Univ. of Florida, CAO (USA)
- Univ. of Naples "Federico II"
- Univ. of Naples "L'Orientale"
- Univ. of Naples Parthenope
- Univ. of Sheffield (UK)

Main results (2022-2024)

- 49 Publications**
 - Journal papers (27)
 - Book chapters (8)
 - Conference papers (10)
 - Technical Reports (4)
- 4 publicly available Datasets**
- 7 publicly available Software Packages**
- 4 Keynote Talks**
- 4 Journal Special Issues**
- Organization of 4 International Conferences**
- + 5 Dissemination Events**

XX WORKSHOP CNR-ICAR
25-27 SETTEMBRE 2024 MANGIA'S POLLINA RESORT SICILY