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PIANO NAZIONALE
DI RIPRESA E RESILIENZA



Centro Nazionale di Ricerca in HPC,
Big Data and Quantum Computing

WP3 Status Report

F. Vitello - F. Gargano

Spoke 3 General Meeting, Elba 5-9 / 05, 2024

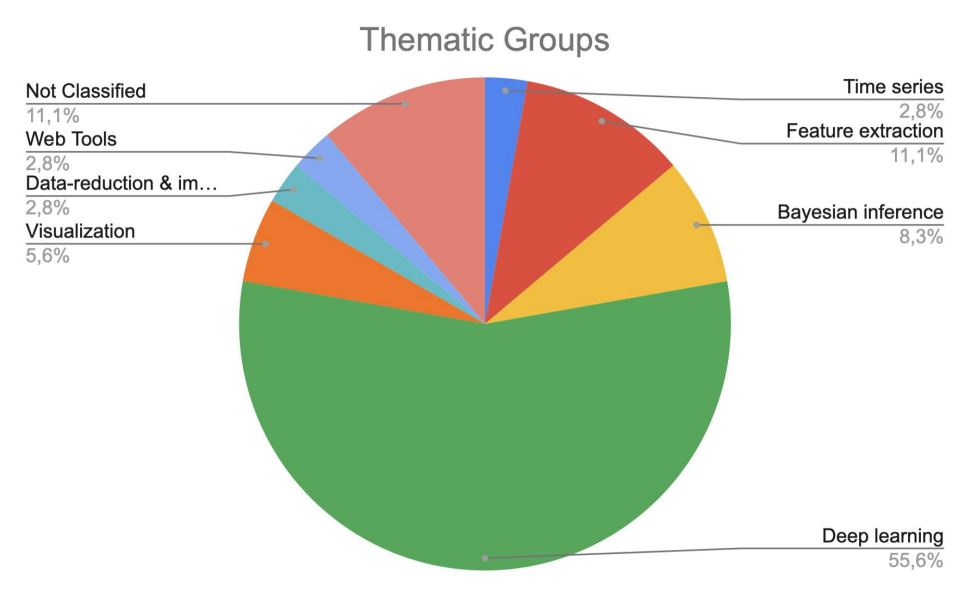
Scientific Rationale

- To **develop new methods and/or optimize existing prototype Machine Learning applications** for the automated processing of large and complex data;
- To **develop and optimize existing solutions for high performance visualization**, addressing on-site and remote visualization;
- To **develop integrated solutions starting from the outcome of the previous actions**, in order to provide a unique and optimized eco-system for big and complex data sets.



WP3 Organization

- **Regular Meeting:** first Tuesday of each month.
 - Offline report writing + Discussion on the activities carried out during the month;
 - Good general participation, with some criticalities (mainly related to recruitment);
- 35 declared **use cases** (15 are labeled as certain)
 - Time series: 1 use case;
 - Feature extraction: 4 use cases;
 - Bayesian inference: 3 use cases;
 - Deep learning: 20 use cases;
 - Visualization: 2 use cases;
 - Data-reduction & imaging: 1 use case;
 - Web Tools: 1 use case;
 - Not Classified: 4 use cases.



Recruitment

Ente	Posizione (TD/PhD/Ad)	Numero di Anni	Referente	Stato del bando (emesso il..o da emettere entro il o utilizzo graduatoria entro il)	Data Assunzione (Effettiva o Previs)	WPs	% FTE WP1 WP2	% FTE WP	% FTE WP	% FTE WP	Nominativo
INAF	TD	2	Gheller/Brunetti	Assegnato	1 febbraio 2024	WP3		100%			Chiara Stuardi
INAF	ADR	2	Taffoni OATS	Bando Giugno 2023	1 settembre 2023	WP3					Stefano Russo
INAF	TD	2	Possenti OACA	utilizzo graduatoria catania	8 aprile 2024	WP3		100%			Eleonora Villa
INAF	PHD	3	Riggi OACT	espletato ad Agosto 2022	1 novembre 2022	WP3		100%			Thomas Ceconello
INAF	TD	1	Vitello OACT	Reclutamento in corso	1 giugno 2024	WP3		100%			
INAF	TD	2	Carbone IASF-MI	utilizzo graduatoria Catania	9 febbraio 2024	WP3		100%			Lorenzo Piga
INAF	AdR	1	OaCT	1 posizione bando entro Giugno 2024		WP3					
UNITO	RTDa	2	Susanna Terracini	Concorso espletato	01/04/2023	(WP3)					Irene De Blasi
INFN	TD	2	Fabio Gargano	Concorso espletato	15/5/2023	WP3		100%			Federica Cuna
INFN	TD	2	Massimiliano Lattanzi	Concorso espletato	1/6/2023	WP1-WP3	50%	50%			Paolo Campeti
INFN	TD	2	Pasquale Lubrano	Concorso espletato	1/12/2023	WP3-WP5		50%		50%	Maria Bossa
INFN	Borsa Tecnologica	2	Dario Gasparini	Concorso Espletato	1/10/2023	WP3-WP5		50%		50%	Matteo Pasqui
INFN	Borsa Tecnologica	2	Stefano Della Torre	Concorso Espletato	1/9/2023	WP1-WP3	50%	50%			Giovanni Cavallotto
INFN	Borsa Tecnologica	2	Melissa Pesce-Rollins	Concorso Espletato	1/10/2023	WP3		100%			Andrea Sabatucci
INFN	Borsa Tecnologica	2	Pasquale Lubrano	Concorso Espletato	1/9/2023	WP3-WP4		60%	40%		Andrea Adelfio
UNITOV	Tecnologo	2,5		Concorso espletato	07/03/2023	WP1-WP2-WP3					Simone Ferretti
UNITOV	PhD	3		Concorso espletato	08/02/2023	WP1-WP2-WP3					Avinash Anand
UNITOV	PhD	3		Concorso espletato	01/08/2023	WP3					Karina Belen Baeza Villagra
UNICT	RTDa	3		Concorso espletato	01/03/2023	WP3					Grassia Marco
SISSA	AdR	2	Roberto Trotta	Concorso espletato	01/05/2023	WP2-WP3	50%	50%			Chiara Moretti
SNS	PhD	3		Concorso Espletato	02/09/2023	WP3					Nikolaos Triantafyllou
SNS	PhD	3		Concorso Espletato	02/09/2023	WP3					Yilong Zhang
SNS	PhD	3		Concorso Espletato	25/03/2024	WP3					Yilong Zhang

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SNS	PhD	3		Concorso Espletato	25/03/2024	WP3					Yilong Zhang

23 people
(some shared with other WPs)

Publications

Authors	Institute		Title
De Blasi	Unito	Accepted for Astrophysics and Space Science	Analytical methods in Celestial Mechanics: satellites' stability and galactic billiards
Gómez-Valent, A.; Favale, A.; Migliaccio, M.; Sen, A. A.,	RomaToV	Physical Review D, Volume 109, Issue 2, article id.023525 (2024)	Late-time phenomenology required to solve the H0 tension in view of the cosmic ladders and the anisotropic and angular BAO datasets
Favale, A.; Gómez-Valent, A.; Migliaccio, M.	RomaToV	Monthly Notices of the Royal Astronomical Society, Volume 523, Issue 3, pp.3406-3422 (2023)	Cosmic chronometers to calibrate the ladders and measure the curvature of the Universe. A model-independent study
K . Karchev, R. Trotta & C. Weniger (2023)	Sissa	NeurIPS 2023 workshop Machine Learning and the Physical Science	SimSIMS: Simulation-based Supernova Ia Model Selection with thousands of latent variables
D. Breitman, A. Mesinger, S. Murray, D. Prelogovic, Y. Qin & R. Trotta (2024)	SNS (Breitman, Mesinger, Murray, Prelogovic), Sissa (Trotta)	Monthly Notices of the Royal Astronomical Society, Volume 527, Issue 4, February 2024, Pages 9833–9852	21cmEMU: an emulator of 21cmFAST summary observables
K . Karchev, M. Grayling, B. Boyd, R. Trotta, K. Mandel & C. Weniger (2024)	Sissa	Accepted for MNRAS	SIDE-real: Truncated marginal neural ratio estimation for Supernova Ia Dust Extinction with real data
G. Nunnari, S. Calvari	UniCT	Geomatics 2024, 4, 124–137.	Exploring Convolutional Neural Networks for the Thermal Image Classification of Volcanic Activity
Greig, Bradley ; Prelogović, David ; Mirocha, Jordan ; Qin, Yuxiang ; Ting, Yuan-Sen search by orcid ; Mesinger, Andrei	SNS	Preprint	Exploring the role of the halo mass function for inferring astrophysical parameters during reionisation
Greig, Bradley ; Prelogović, David ; Qin, Yuxiang ; Ting, Yuan-Sen; Mesinger, Andrei	SNS	Preprint	Inferring astrophysical parameters using the 2D cylindrical power spectrum from reionisation
Prelogović, David ; Mesinger, Andrei	SNS	Preprint	How informative are summaries of the cosmic 21-cm signal?
Prelogović, David; Mesinger, Andrei	SNS	Monthly Notices of the Royal Astronomical Society, Volume 524, Issue 3, September 2023, Pages 4239–4255	Exploring the likelihood of the 21-cm power spectrum with simulation-based inference
Cammarota, V.; Marinucci, D.; Salvi, M.; Vigogna, S.	RomaToV	Modern Stochastics: Theory and Applications, Vol. 11, No. 1, 85-108 (2024)	A quantitative functional central limit theorem for shallow neural networks
Favaro, S.; Hanin, B.; Marinucci, D.; Nourdin, I.; Peccati, G.	RomaToV	Preprint	Quantitative CLTs in Deep Neural Networks

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De Blasi	Unito	Accepted for Astrophysics and Space Science Analytical methods in Celestial Mechanics: satellites' stability and galactic billiards
Gómez-Valent, A.; Favale, A.; Migliaccio, M.; Sen, A. A.,	RomaToV	Physical Review D, Volume 109, Issue 2, article id.023525 (2024) Late-time phenomenology required to solve the H0 tension in view of the cosmic ladders and the anisotropic and angular BAO datasets
Favale, A.; Gómez-Valent, A.; Migliaccio, M.	RomaToV	Monthly Notices of the Royal Astronomical Society, Volume 523, Issue 3, p. 3451–3461 (2024)
K . Karchev, R. Trotta & C. Weniger (2023)	Sissa	NeurIPS 2023 workshop on Physics of Machine Learning Physical Science
D. Breitman, A. Mesinger, S. Murray, D. Prelogovic, Y. Qin & R. Trotta (2024)	SNS (Breitman, Mesinger, Murray, Prelogovic), Sissa (Trotta)	Monthly Notices of the Royal Astronomical Society, Volume 527, Issue 4, p. 4511–4521 (2024)
K . Karchev, M. Grayling, B. Boyd, R. Trotta, K. Mandel & C. Weniger (2024)	Sissa	Accepted for MNRAS
G. Nunnari, S. Calvari	UniCT	Geomatics 2024, 4, 12
Greig, Bradley ; Prelogović, David ; Mirocha, Jordan ; Qin, Yuxiang ; Ting, Yuan-Sen search by orcid ; Mesinger, Andrei	SNS	Preprint
Greig, Bradley ; Prelogović, David ; Qin, Yuxiang ; Ting, Yuan-Sen; Mesinger, Andrei	SNS	Preprint
Prelogović, David ; Mesinger, Andrei	SNS	Preprint How informative are summaries of the cosmic 21-cm signal?
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Favaro, S.; Hanin, B.; Marinucci, D.; Nourdin, I.; Peccati, G.	RomaToV	Preprint Quantitative CLTs in Deep Neural Networks

Not only publications:

- Codes (on private repositories);
- Catalogue/datasets (on private drive/repositories);
- Conference presentations;
- Reports;

Milestone 6

Code

Report

Publication

Dataset

- **TAR3.1** Neural Network for galactic emission: development of a ResUNET solution
 - **KPI:** Github repository available
- **TAR3.2** Space experiment: track reconstruction
 - **KPI:** Github repository available
- **TAR3.3** Deep Learning for Supernovae: synthetic data generation, first model implementation
 - **KPI:** Code repository available
- **TAR3.4** GAIA: analysis of Machine Learning methods to select features for the RR Lyrae metallicity estimation
 - **KPI:** Documents
- **TAR3.5** LiteBIRD experiment for HST: Study of the state of art of the time series ML generative algorithms and define the infrastructure
 - **KPI:** First code release and documents
- **TAR3.6** 21-cm power spectrum: precision Bayesian inference algorithms development
 - **KPI:** First code release, publication
- **TAR3.7** Design of a Neural network to improve galactic emission for cosmic microwave background measurements
 - **KPI** publication

Milestone 6

Code | Report | Publication | Dataset

- **TAR3.8** Machine Learning for complex N-body problems: preliminary code implementation
 - **KPI:** code release on private repository and documentation
- **TAR3.9** Astronomical images segmentation with Machine Learning: Produce an updated version of caesar-mrcnn source finder based on TensorFlow v2.
 - **KPI:** code release on public repository
- **TAR3.10** Self-Supervised techniques in Radioastronomy: first code implementation and dataset collection
 - **KPI:** code release on public repository and documentation
- **TAR3.11** Bayesian inference of cosmological parameters from BOSS data: problem analysis
 - **KPI:** publication
- **TAR3.12** Generative Deep Learning Networks for cosmological simulations: generate the training data.
 - **KPI:** Dataset available
- **TAR3.13** WP3 Activity monitoring
 - **KPI:** Periodic teleconferences minutes;

Milestone 7

Code

Report

Publication

Dataset

- **TAR3.1** Neural Network for galactic emission: extend maps in unobserved areas.
 - **KPI:** Github repository available
- **TAR3.2** Space experiment: improved track reconstruction
 - **KPI:** Github repository available
- **TAR3.3** Deep Learning for Supernovae: model refinement and code development.
 - **KPI:** Code repository available
- **TAR3.4** GAIA: Application of Bayesian analysis to measure metallicity of RR Lyrae stars.
 - **KPI:** Documents and Code Repository
- **TAR3.5** LiteBIRD experiment for HST: Development of the generative adversarial network prototype
 - **KPI:** Code release and documents:
- **TAR3.6** 21-cm power spectrum: precision Bayesian inference algorithms validation
 - **KPI:** First code release, publication
- **TAR3.7** Machine Learning for complex N-body problems: code implementation on beta stage
 - **KPI:** code release on private repository and documentation
- **TAR3.8** Astronomical images segmentation with Machine Learning: Astronomical images segmentation with Machine Learning: caesar-mrcnn pre-training runs
 - **KPI:** code release on public repository and conference paper

Milestone 7

Code

Report

Publication

Dataset

- **TAR3.9** Self-Supervised techniques in Radioastronomy: first code implementation and dataset collection
 - **KPI:** code release on public repository and documentation
- **TAR3.10** Bayesian inference of cosmological parameters from BOSS data: The StratLearn method for photometric redshift estimation.
 - **KPI:** publication and code repository
- **TAR3.11** Generative Deep Learning Networks for cosmological simulations: generate the simulation.
 - **KPI:** Publication and dataset available
- **TAR3.12** Map-Level Emulator of CMB systematics: definition of an appropriate machine learning algorithm.
 - **KPI:** Dataset available
- **TAR3.13** Organization of the Kick-Off meeting of the project HAZard Mapping and vulnerability MONitoring (HaMMon)
 - **KPI:** kickoff meeting
- **TAR3.14** WP3 Activity monitoring
 - **KPI:** Periodic teleconferences
- **TAR3.15** Data Augmentation for TOD data
 - **KPI:** Reports
- **TAR3.16** Weak Lensing
 - **KPI:** Documents

Open Access Repository

Open Access Repository

Spoke 3 - WP3 repository

All versions

Access Right

- Open (3)
- Restricted (1)

File Type

- Pdf (3)
- Docx (1)

Keywords

- Wp3 (2)
- 3d (1)
- Agisoft (1)
- Cloud (1)
- Dem (1)
- Dense (1)
- Digital (1)
- Icsc (1)
- Mesh (1)
- Metashape (1)

Type

- Publication (4) +

Found 4 results. < 1 >

Sort by: Most recent asc.

February 29, 2024 (v1) Report Open Access View

Algorithm for creation of digital twin from UAV

Leonardo Pelonero, Fabio Roberto Vitello;

The report specifically focuses on the creation of digital twins using UAV (Unmanned Aerial Vehicle) photogrammetry techniques. It offers functionalities for processing aerial imagery, generating 3D models, and creating digital representations of real-world environments

Uploaded on March 19, 2024.

January 25, 2024 (0) Report Restricted Access View

A Map-level Emulator of CMB Systematics. Description of the algorithm and implementation strategy.

Paolo Campeti, Martina Gerbino, Massimiliano Lattanzi, Luca Pagano;

We propose to tackle is the extremely high computational expense associated to the production of end-to-end simulations of time-ordered data for Cosmic Microwave Background (hereafter CMB) experiments with a map-based emulator.

Uploaded on January 25, 2024.

January 24, 2024 (Preprint) Journal article Open Access View

Analytical methods in Celestial Mechanics: satellites' stability and galactic billiards

Irene De Biasi;

In this paper, two models of interest for Celestial Mechanics are presented and analysed, using both analytic and numerical techniques, from the point of view of the possible presence of regular and/or chaotic motion, as well as the stability of the considered orbits. The first model, presented in a

Uploaded on January 24, 2024.

January 22, 2024 (v1) Journal article Open Access View

Report on Machine Learning techniques for astrophysical analyses - versione 1

Andrea Adelfio;

Report sulle tecniche di Machine Learning per analisi astrofisiche.

Uploaded on January 22, 2024.

https://www.openaccessrepository.it/communities/spoke3_wp3

Innovation Grants, KSP, Cascade Funds

Innovation Grants:

- HaMMon (Hazard Mapping and vulnerability Monitoring)
- Fraud Detection
- Time series in the banking sector

Key Science Project:

- **4 projects** linked to WP3 Activities: SKA (and Pathfinders) Regional Center HPC Services, STEDDAS. Revealing the populations of compact remnants in dense stellar systems, Multi-wavelength inference from the first billion years, VisIVO

Cascade Funds:

- ~15 sub themes and objectives linked to WP3 activities;

Timescale, Milestones and KPIs

- Spoke 3 General meeting (Catania, June 2023): 1 talk
- Spoke 3 Technical meeting (Trieste, October 2023): 13 talks
- Spoke 3 General meeting (Isola d'Elba, May 2024): 19 talks

Self-supervision on radio data for source analysis	Thomas Cecconello	09:15 - 09:30
Machine Learning/Deep Learning algorithms for Gaia mission data analysis	Dr Lorenzo Monti	09:30 - 09:45
Radio U-Net: the convolutional neural network for diffuse radio sources detection	Chiara Stuardi	09:45 - 10:00
Enhanced LSS cosmological simulations with ML techniques	Lorenzo Piga	10:00 - 10:15
ML for Cluster Cosmology analysis	Matteo Costanzi Alunno Cerbolini	10:15 - 10:30
Coffee break		10:30 - 11:00
Symmetric solutions for the N-body problem: a computational approach	Irene De Biasi	11:00 - 11:15
Improving photo-z estimation under covariate shift with StratLearn	Chiara Moretti	11:15 - 11:30
Simulation-Based Inference for realistic Supernova Type Ia data	Roberto Trotta	11:30 - 11:45
The Euclid survey: Improving cosmological constraints via BAO reconstruction	Elena Sarpa	11:45 - 12:00

The Euclid survey: Improving cosmological constraints via BAO reconstruction	Elena Sarpa	11:45 - 12:00
Deep learning of 87A-like supernovae progenitor	Marco Grassia	12:00 - 12:15
Graph neural network for track reconstruction in space experiments	Federica Cuna	12:15 - 12:30
Map-level Emulation of CMB experimental systematics	Paolo Campeti	12:30 - 12:45
Generative AI for cosmic rays background data augmentation for LiteBIRD experiment	Giovanni Cavallotto	12:45 - 13:00
Machine Learning Techniques for Space Calorimeter Experiments	Maria Bossa	14:30 - 14:45
Allucinating molecular cloud emission with Neural nets	Giuseppe Puglisi	14:45 - 15:00
Chemical tagging of field RR Lyrae to constrain the early formation and	Karina Baeza Villagra	15:00 - 15:15
Optimal compression and Simulation-Based Inference of the cosmic 21-cm signal	Andrei Mesinger	15:15 - 15:30
Anomaly Detection in Time Series from the Fermi Anti-Coincidence Detector with Machine Learning Techniques	Mr Andrea Adelfio	
Speeding up the Bayesian Inference Pipeline for the detection of nanoHertz GWs	Eleonora Villa	15:45 - 16:00

ICSC is supporting as a sponsor the **2nd edition of the “International Conference on Machine Learning for Astrophysics” ML4ASTRO2**

The conference aims to unite leading researchers actively engaged in applying machine learning to astrophysical studies. Engaging discussions will revolve around the innovative application of AI models to observational and simulation data.

Date: 8 - 12 July

Where: Catania (Italy)

More info: <https://indico.ict.inaf.it/event/2690>

Photo: NASA, ESA, the Hubble Heritage Team (STScI/AURA), A. Nota (ESA/STScI), and the Westerlund 2 Science Team

The international conference exploring challenges and opportunities presented by the Big Data era in Astronomy

MACHINE LEARNING FOR ASTROPHYSICS

2ND EDITION CATANIA, 8-12 JULY, 2024

SCIENTIFIC HIGHLIGHTS

- The event will showcase cutting-edge AI methodologies tailored for addressing key open problems.
- Past and future multiwavelength/all-sky surveys
- Time domain
- Cosmology & Simulations
- Astroparticles, cosmic rays, neutrinos
- Astronomical infrastructure: design, control and forecasting

INVITED SPEAKERS

- DALYA BARON**
Carnegie Observatories, USA
- DANIELA HUPPENKOTHEN**
Netherlands Institute for Space Research, Netherlands
- DEAGLAN J. BARTLETT**
Institut d'Astrophysique de Paris (CNRS & Sorbonne Université), France
- FRANCISCO FÖRSTER BURÓN**
Universidad de Chile, Chile
- FRANCISCO VILLAESCUSA-NAVARRO**
Simons Foundation, NY, USA
- JONAS GLOMBITZA**
Erlangen Centre for Astroparticle Physics, Germany
- TAO AN**
Shanghai Astronomical Observatory, China
- YUAN-SEN TING**
Australian National University, Australia, and Ohio State University, USA

SCIENTIFIC ORGANIZING COMMITTEE

F. Bufano, A. De Marco, F. Förster Burón, A. Hopkins, G. Puglisi, M. L. Pumo, S. Riggi, E. Sciacca, S. Trujillo, F. Villaescusa

LOCAL ORGANIZING COMMITTEE

C. Bordiu, M. Zanotti, F. Farsian, F. Incardona, G. Tudisco, N. Tuccari

Aula Magna
Università degli Studi di Catania
Dipartimento di Fisica e Astronomia
Via S. Sofia, 64 - 95123 Catania - Italy

indico.ict.inaf.it/event/ml4astro2

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