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Valerio Pampanoni

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WORK EXPERIENCE

SCHOOL OF AEROSPACE ENGINEERING – ROME, ITALY

RESEARCH FELLOW – 12/2018 – CURRENT

I work as a research fellow at the Earth Observation and Satellite Image Analysis Laboratory (EOSIAL). My main area of interest is using satellite data for fire management, covering all three phases of firefighting: prevention, detection and reaction. Originally I was involved in the ASI project Integrated Fire Management Satellite System (S2IGI), and later in the Horizon 2020 FirEUrisk Project, where, among other contributions, I served as task leader in task A1.1.1 dedicated to fire weather and fuel status prevention and worked on the very first European Live Fuel Moisture Content product based on Sentinel-3 imagery.
I was also involved in collaborations with Serco and Terna.

My collaboration with Serco started with the development of a methodology and software for the assessment of satellite image sharpness in the framework of the ESA CQC Harmonisation Initiatives. This work initially produced in an innovative, semi-automatic approach that resulted in publications on IEEEXplore and MDPI Remote Sensing. The approach was later updated to fully automatic, and spawned further publications in journals and presentations at workshops and conferences. During this collaboration, I also developed a state of the art shoreline mapping method for high and medium resolution satellite images, using computer vision and machine learning to automate the shoreline detection process.

With Terna I worked on a system for the detection of wildfires from the geostationary orbit focused on events potentially threatening the electrical network.

ENEA CASACCIA RESEARCH CENTER – ROME, ITALY

INTERN – 03/2018 – 08/2018

I worked at the "Engineering, Processes and Systems for Energy" Laboratory of the ENEA Casaccia Research Center under the supervision of Dr. Salvatore Scaglione. My job was the repurposing and calibration of the FRAD UV-Radiometer, which was conceived for operation in Antarctica, for operation in Mediterranean climates.

EDUCATION AND TRAINING

01/11/2020 – 25/01/2023 Rome , Italy

PHD IN ENERGY AND ENVIRONMENT La Sapienza University of Rome

Website https://phd.uniroma1.it/web/ENERGY-AND-ENVIRONMENT_nD3496_EN.aspx | **Level in EQF** EQF level 8

08/2015 – 10/2018 Rome, Italy

MASTER'S DEGREE IN SPACE AND ASTRONAUTICAL ENGINEERING La Sapienza University of Rome

Website https://corsidilaurea.uniroma1.it/en/corso/2024/31825/home | **Field of study** Space Engineering |

Final grade 110/110 cum laude | **Level in EQF** EQF level 7 |

Thesis Application of Remote Sensing Techniques to the Detection of Ozone in the Martian Atmosphere

08/2012 – 03/2015 Rome, Italy

BACHELOR'S DEGREE IN AEROSPACE ENGINEERING La Sapienza University of Rome

Website https://corsidilaurea.uniroma1.it/en/corso/2018/29394/home | **Field of study** Aerospace Engineering |

Final grade 110/110 | **Level in EQF** EQF level 6 | **Thesis** 1U Cubesat Manufacturing and Testing with Magnetic Attitude Control

PUBLICATIONS

2024

Analysing the relationship between spatial resolution, sharpness and signal-to-noise ratio of very high resolution satellite imagery using an automatic edge method

Assessing the performance of optical imaging systems is crucial to evaluate their capability to satisfy the product requirements for an Earth Observation (EO) mission. In particular, the evaluation of image quality is undoubtedly one of the most important, critical and problematic aspects of remote sensing. It involves not only pre-flight analyses, but also continuous monitoring throughout the operational lifetime of the observing system. The Ground Sampling Distance (GSD) of the imaging system is often the only parameter used to quantify its spatial resolution, i.e., its capability to resolve objects on the ground. In practice, this feature is also heavily influenced by other image quality parameters such as the image sharpness and Signal-to-Noise Ratio (SNR). However, these last two aspects are often analysed separately, using unrelated methodologies, complicating the image quality assessment and posing standardisation issues. To this end, we expanded the features of our Automatic Edge Method (AEM), which was originally developed to simplify and automate the estimate of sharpness metrics, to also extract the image SNR. In this paper we applied the AEM to a wide range of optical satellite images characterised by different GSD and Pixel Size (PS) with the objective to explore the nature of the relationship between the components of overall image quality (image sharpness, SNR) and product geometric resampling (expressed in terms of GSD/PS ratio). Our main objective is to quantify how the sharpness and the radiometric quality of an image product are affected by different product geometric resampling strategies, i.e., by distributing imagery with a PS larger or smaller than the GSD of the imaging system. The AEM allowed us to explore this relationship by relying on a vast amount of data points, which provide a robust statistical significance to the results expressed in terms of sharpness metrics and SNR means. The results indicate the existence of a direct relationship between the product geometric resampling and the overall image quality, and also highlight a good degree of correlation between the image sharpness and SNR.

Pampanoni, Valerio, et al. "Analysing the relationship between spatial resolution, sharpness and signal-to-noise ratio of very high resolution satellite imagery using an automatic edge method." Remote Sensing 16.6 (2024): 1041.

Authors: Valerio Pampanoni, Fabio Fascetti, Luca Cenci, Giovanni Laneve, Carla Santella, Valentina Boccia | **Journal Name**: Remote Sensing | **Volume, Issue and Pages**: 16, 6, 1041 | **Publisher**: MDPI

2023

Towards an integrated approach to wildfire risk assessment: when, where, what and how may the landscapes burn

This paper presents a review of concepts related to wildfire risk assessment, including the determination of fire ignition and propagation (fire danger), the extent to which fire may spatially overlap with valued assets (exposure), and the potential losses and resilience to those losses (vulnerability). This is followed by a brief discussion of how these concepts can be integrated and connected to mitigation and adaptation efforts. We then review operational fire risk systems in place in various parts of the world. Finally, we propose an integrated fire risk system being developed under the FirEUrisk European project, as an example of how the different risk components (including danger, exposure and vulnerability) can be generated and combined into synthetic risk indices to provide a more comprehensive wildfire risk assessment, but also to consider where and on what variables reduction efforts should be stressed and to envisage policies to be better adapted to future fire regimes. Climate and socio-economic changes entail that wildfires are becoming even more a critical environmental hazard; extreme fires are observed in many areas of the world that regularly experience fire, yet fire activity is also increasing in areas where wildfires were previously rare. To mitigate the negative impacts of fire, those responsible for managing risk must leverage the information available through the risk assessment process, along with an improved understanding on how the various components of risk can be targeted to improve and optimize the many strategies for mitigation and adaptation to an increasing fire risk.

Chuvieco, Emilio, et al. "Towards an integrated approach to wildfire risk assessment: when, where, what and how may the landscapes burn." Fire 6.5 (2023): 215.

Authors: Emilio Chuvieco, Marta Yebra, Simone Martino, Kirsten Thonicke, Marta Gómez-Giménez, Jesus San-Miguel, Duarte Oom, Ramona Velea, Florent Mouillot, Juan R Molina, Ana I Miranda, Diogo Lopes, Michele Salis et al | **Journal Name**: Fire | **Volume, Issue and Pages**: 6, 5, 215 | **Publisher**: MDPI

2021

Presenting a Semi-Automatic, Statistically-Based Approach to Assess the Sharpness Level of Optical Images from Natural Targets via the Edge Method. Case Study: The Landsat 8 OLI–L1T Data

Developing reliable methodologies of data quality assessment is of paramount importance for maximizing the exploitation of Earth observation (EO) products. Among the different factors influencing EO optical image quality, sharpness has a relevant role. When implementing on-orbit approaches of sharpness assessment, such as the edge method, a crucial step that strongly affects the final results is the selection of suitable edges to use for the analysis. Within this context, this paper aims at proposing a semi-automatic, statistically-based edge method (SaSbEM) that exploits edges extracted from natural targets easily and largely available on Earth: agricultural fields. For each image that is analyzed, SaSbEM detects numerous suitable edges (e.g., dozens-hundreds) characterized by specific geometrical and statistical criteria. This guarantees the repeatability and reliability of the analysis. Then, it implements

a standard edge method to assess the sharpness level of each edge. Finally, it performs a statistical analysis of the results to have a robust characterization of the image sharpness level and its uncertainty. The method was validated by using Landsat 8 L1T products. Results proved that: SaSbEM is capable of performing a reliable and repeatable sharpness assessment; Landsat 8 L1T data are characterized by very good sharpness performance.

https://doi.org/10.3390/rs13081593

Link https://www.mdpi.com/2072-4292/13/8/1593/pdf

2020

The Daily Fire Hazard Index: A Fire Danger Rating Method for Mediterranean Areas

Mediterranean forests are gravely affected by wildfires, and despite the increased prevention effort of competent authorities in the past few decades, the yearly number of fires and the consequent damage has not decreased significantly. To this end, a number of dynamical methods have been developed in order to produce short-term hazard indices, such as the Fire Probability Index and the Fire Weather Index. The possibility to estimate the fire hazard is based on the observation that there is a relationship between the characteristics of the vegetation (i.e., the fuel), in terms of abundance and moisture content, and the probability of fire insurgence. The density, type, and moisture content of the vegetation are modeled using custom fuel maps, developed using the latest Corine Land Cover, and using a number of indices such as the NDVI (Normalized Difference Vegetation Index), Global Vegetation Moisture Index (GVMI), and the evapotranspiration, derived from daily satellite imagery. This paper shows how the algorithm for the calculation of the Fire Potential Index (FPI) was improved by taking into account the effect of wind speed, topography, and local solar illumination through a simple temperature correction, preserving the straightforward structure of the FPI algorithm. The results were validated on the Italian region of Sardinia using official wildfire records provided by the regional administration

https://doi.org/10.3390/rs12152356

Link https://www.mdpi.com/2072-4292/12/15/2356/pdf

2025

Assessing predictors for fuel moisture content in Central European forests

The moisture content of litter, woody debris and living vegetation controls the ignition and spread of fires and the composition of fire emissions. Since many forests in Central Europe were not considered fire-prone, very few observations and knowledge about fuel moisture content (FMC) are available. In this study, we aim to evaluate the representativeness of (i) continuous FMC measurements from *in situ* fuel sticks, (ii) a model of litter fuel moisture (Koba model) and (iii) a vapour pressure deficit based model for FMC of litter and woody debris across four temperate forest sites in Germany. Following this, we investigate fire weather indices from *in situ* meteorological or large-scale models and satellite products as potential predictors of live and dead FMC in a correlation analysis and using univariate generalised additive models (GAM). Our results suggest that continuous 10-hour fuel stick measurements are predominantly in agreement with litter FMC in coniferous and deciduous stands. The Koba model shows a very high correlation with dead-FMC. Among the components of the fire weather index, the fine fuel moisture code emerged as the best predictor of fuel stick measurements (GAM performance: R2=0.87, RMSE=4.1%), reflecting the expected relationship to destructively measured *in situ* FMC of litter and fine woody debris. FMC of live fuels is not or only weakly correlated with meteorological variables but moderate correlation was achieved with live-FMC retrievals from the Sentinel-1 radar satellite. The fire weather index from the European Forest Fire Information System (EFFIS) underestimates the variability of locally measured fire weather and FMC. In summary, our results demonstrate the potential of local fire weather, fuel moisture measurements and of the litter fuel moisture model to enhance an accurate assessment of forest fire danger in Central European forests.

Johanna Kranz, Konrad Bauer, Valerio Pampanoni, Li Zhao, Christopher Marrs, Matthias Mauder, Markéta Poděbradská, Marieke van der Maaten-Theunissen, Marta Yebra, Matthias Forkel

Authors: Johanna Kranz, Konrad Bauer, Valerio Pampanoni, Li Zhao, Christopher Marrs, Matthias Mauder, Markéta Poděbradská, Marieke van der Maaten-Theunissen, Marta Yebra, Matthias Forkel | **Journal Name**: Agricultural and Forest Meteorology | **Volume, Issue and Pages**: 371

2023

Mapping opportunities for the use of land management strategies to address fire risk in Europe

Many parts of Europe face increasing challenges managing wildfires. Although wildfire is an integral part of certain ecosystems, fires in many places are becoming larger and more intense, driven largely by climate change, land abandonment, and changes in fuel management with important socioeconomic, environmental, and ecosystem services consequences for Europe. In order to envision a comprehensive fire risk mitigation strategy for Europe, a spatial assessment of opportunities to manage fuels at the landscape-scale is needed. Our study explored the suitability of three land management strategies (LMS)—herbivory, mechanical fuel removal, and prescribed burn—

which can create more heterogenous fuelscapes, thereby reducing an element of fire risk. We created suitability maps for each of the LMS using adoption factors identified in a systematic literature review (n = 123). We compared these maps with areas of historical fire occurrence as a proxy for fire risk to prioritize key areas for intervention. We found that over a quarter of Europe was suitable for multiple LMS within areas of greater fire risk, creating opportunities for concurrent and synergistic use of the strategies. Options were more limited in areas of southern Europe, where prescribed burn was found to be uniquely viable amongst the LMS evaluated. Opportunities were also restricted in some areas of high fire risk in northern Europe, where herbivory was found to be the only suitable LMS. Our findings take a wide-view of fuel management to target landscape-scale decision making focused on reducing fire risk. However, many other factors must be taken into account to successfully manage fuels at local scales, including the socio-cultural appropriateness of the LMS, the viability of incentive schemes, and possible trade-offs with other management goals, such as carbon storage and biodiversity.

Neidermeier, A. N., et al. "Mapping opportunities for the use of land management strategies to address fire risk in Europe." Journal of environmental management 346 (2023): 118941.

Authors: AN Neidermeier, C Zagaria, V Pampanoni, TAP West, PH Verburg | **Journal Name**: Journal of environmental management | **Volume, Issue and Pages**: 346 | **Publisher**: Elsevier

Progress and limitations in the satellite-based estimate of burnt areas

The detection of burnt areas from satellite imagery is one of the most straightforward and useful applications of satellite remote sensing. In general, the approach relies on a change detection analysis applied on pre- and post-event images. This change detection analysis usually is carried out by comparing the values of specific spectral indices such as: NBR (normalised burn ratio), BAI (burn area index), MIRBI (mid-infrared burn index). However, some potential sources of error arise, particularly when near-real-time automated approaches are adopted. An automated approach is mandatory when the burnt area monitoring should operate systematically on a given area of large size (country). Potential sources of errors include but are not limited to clouds on the pre- or post-event images, clouds or topographic shadows, agricultural practices, image pixel size, level of damage, etc. Some authors have already noted differences between global databases of burnt areas based on satellite images. Sources of errors could be related to the spatial resolution of the images used, the land-cover mask adopted to avoid false alarms, and the quality of the cloud and shadow masks. This paper aims to compare different burnt areas datasets (EFFIS, ESACCI, Copernicus, FIRMS, etc.) with the objective to analyse their differences. The comparison is restricted to the Italian territory. Furthermore, the paper aims to identify the degree of approximation of these satellite-based datasets by relying on ground survey data as ground truth. To do so, ground survey data provided by CUFA (Comando Unità Forestali, Ambientali e Agroalimentari Carabinieri) and CFVA (Corpo Forestale e Vigilanza Ambientale Sardegna) were used. The results confirm the existence of significant differences between the datasets. The subsequent comparison with the ground surveys, which was conducted while also taking into account their own approximations, allowed us to identify the accuracy of the satellite-based datasets.

Laneve, G., Di Fonzo, M., Pampanoni, V., & Bueno Morles, R. (2023). Progress and limitations in the satellite-based estimate of burnt areas. Remote Sensing, 16(1), 42.

Authors: Giovanni Laneve, Marco Di Fonzo, Valerio Pampanoni, Ramon Bueno Morles | **Journal Name**: Remote Sensing | **Volume, Issue and Pages**: 16, 1 | **Publisher**: MDPI

CONFERENCES AND SEMINARS

Milan, Italy
13th EARSeL Workshop on Forest Fires 2024

I gave a presentation titled "A Glimpse into the Potential Impact of Meteosat Third Generation's Flexible Combined Imager on Wildfire Detection from Satellites" to showcase the potentialities of MTG for the early detection of wildfires from the geostationary orbit.

Link https://forest-fires.earsel.org/workshop/13-FF-2024/

Athens, Greece
2024 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)

Presented my paper titled "Using Prosail Look-Up Tables to Train Random Forests Regressors for Fast Live Fuel Moisture Retrieval". I was also involved in two more papers presented by my colleague Alvise Ferrari:

1. Automating Crop-Field Segmentation in High-Resolution Satellite Images: A U-Net Approach with Optimized Multitemporal Canny Edge Detection
2. Monitoring Methane Emissions from Landfills Using Prisma Imagery

Link https://www.2024.ieeeigarss.org/

15/04/2024 – 17/04/2024 Oran, Algeria

2024 IEEE Mediterranean and Middle-East Geoscience and Remote Sensing Symposium (M2GARSS)

Presented my paper titled "Application of the Daily Fire Danger Index to Algerian Large Fire Events".

Link https://2024.m2garss.org/

16/07/2023 – 21/07/2023 Pasadena, California

2023 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)

Presented my papers:

1. Testing a Novel Scalable-Resolution Fire Danger Index Based on Sentinel Imagery: The Montiferru Megafire Case-Study
2. Early Validation of A Live Fuel Moisture Content Product Based on Sentinel-2 and Sentinel-3 Images

One more paper I was involved in was presented by my colleague Simone Saquella:

- Detection of Irrigated and Rainfed Crops with Machine Learning Multivariate Time-Series Object-Based Classification Using Sentinel-2 Imagery

Link https://2023.ieeeigarss.org/

17/07/2022 – 22/07/2022 Kuala Lumpur

2022 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)

Presented two of my papers:

1. Evaluating Sentinel-3 Viability for Vegetation Canopy Monitoring and Fuel Moisture Content Estimation
2. A fully automatic method for on-orbit sharpness assessment: A case study using prisma hyperspectral satellite images

Link https://igarss2022.org/

25/09/2020 – 01/10/2020 Waikoloa, Hawaii

2020 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)

Presented my paper titled "On-orbit Image Sharpness Assessment using the Edge Method: Methodological Improvements for Automatic Edge Identification and Selection from Natural Targets", currently published on IEEEXplore.

Links https://igarss2020.org/ | https://ieeexplore.ieee.org/document/9324312

02/10/2019 – 04/10/2019 Rome, Italy

12th EARSeL Forest Fire SIG Workshop

Presented my paper titled "Support wildfire management in Mediterranean territories using multi-source satellite images".

Links https://cnrfire2019.eu/ | https://iris.uniroma1.it/handle/11573/1361404

08/09/2019 – 11/09/2019 Rome, Italy

AIDAA 2019 - XXV International Congress of Aeronautics and Astronautics

Presented my paper "Daily fire hazard index for the prevention and management of wildfires in the region of Sardinia".

Links https://www.aidaa.it/ | https://iris.uniroma1.it/handle/11573/1360628

LANGUAGE SKILLS

Mother tongue(s): **ITALIAN**

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken production	Spoken interaction	
ENGLISH	C2	C2	C2	C2	C2
FRENCH	B1	B1	A2	A2	A2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

SKILLS

Programming

Python (Anaconda) Intermediate User | Basic C++ Knowledge | Basic C Knowledge | Matlab Intermediate User

GIS

GDAL | qGIS

Documents and Presentations

Microsoft Word and PowerPoint | LaTeX

COMMUNICATION AND INTERPERSONAL SKILLS

Public Speaking

Giving speeches and presentations is an integral part of my research and PhD activity. In addition to presenting my own research, in many occasions I have been designated to present my team's work due to my confidence both with foreign languages and with public speaking in general. Furthermore, during my PhD I had a number of chances to give lectures to undergraduate students.

Journalism

After cutting my teeth with the Repubblica Scuola project in high school, I collaborated with the independent music webzine Do You Realize for a while. Even after all these years, you can still find some of my articles and some of my micro-reviews in the top charts.

Link http://www.doyourealize.it/