UNIVERSITÀ DEGLI STUDI DI MILANO

Selezione pubblica per la copertura di n. 2 posto/i di Ricercatore a tempo determinato per il settore concorsuale 01/ B1 - INFORMATICA - settore scientifico disciplinare INF/01 - INFORMATICA da coprire mediante chiamata ai sensi dell' art. 24, comma 3, lettera b) della Legge 240/2010 presso il Dipartimento di Informatica Giovanni Degli Antoni - Codice concorso 4957

Luca Magri

Name	Luca Magri
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Highlights

- Assistant Professor (RTD-A) at Dipartimento di Elettronica e Informazione e Bioingegneria (DEIB), Politecnico di Milano; I satisfy the legal requirements to apply for a RTD-b position.
- My major research interests are in *Pattern Recognition* and *Computer Vision*, with a focus on clustering techniques and 3D vision. My most important contributions address methods for multi model fitting and my work has been published in 6 top tier conferences A++, according to GII-GRIN-SCIE conf. ranking (4 CVPR, 1 ECCV and 1 ICCV).
- Publications: 5 articles in peer-reviewed international journals, 20 conference proceedings.
- Publication impact: H-index: 7, citations: 425 (Google scholar). H-index: 6, citations: 237 (Scopus).
- Patents: co-inventor of 2 granted international patents.
- Teaching "Computer Science" undergraduate course, since a.y. 2020-2021, Civil and Environmental Engineering International track, Politecnico di Milano.
- Teaching PhD course "Geometric Computer Vision: from Images to 3D Models" 2021-2022, Univeristà di Trento.
- Overall fund rising by projects and grants sponsored under my supervision (since 2021): 162K€.
- Research projects:
  - *Leader* of research project with Cisco Photonics, Digitiec srl and We wear.
  - *Principal Investigator* of research projects with Gilardoni Raggi X and 3Dflow srl.
- *Supervisor* of 1 PhD grants sponsored by Antares Vision (2021). Co-supervisor of 2 PhD students. Supervisor of 5 MSc thesis students.
- Associate editor of Visual Computer Journal (since January 2022).
- Guest editor of Special Issue NCAA Springer 2022.
- NVIDIA Academic Hardware Grant, 2021.
- ISPRS Young Author Award, XXIV ISPRS Congress, 2020.

Positions and Education

EDUCATION

- PhD in Mathematics and Statistic for Computational Sciences at Università degli Studi di Milano, Milano, Italy. December 2015.
  Title: "*Multiple structure recovery via preference analysis in conceptual space*". INF/01
  Advisor: *A. Fusiello* (Università degli Studi di Udine).
- M.Sc. (laurea specialistica) in Mathematics, at Università degli Studi di Milano, Milano, Italy. December 2012. Final grade: 110/110 cum laude.
  Title: "*Critical loci for dynamic scenes: an application of algebraic geometry to computer vision*".
  Advisor: *M. Bertolini*.
- B.Sc. (laurea triennale) in Mathematics, at Università degli Studi di Milano, Milano, Italy. February 2009. Final grade: 103/110.
  Title: "*Intuitionistic theory of real numbers,*".
  Advisor: *U. Bottazzini*.
- Classic high school diploma from Liceo Classico G.Berchet. Milano, Italy. July 2005. Grade: 100/100.

RECORD OF EMPLOYMENT

June 2021 – Present

Assistant Professor (RTD-A) at Dipartimento di Elettronica, Informazione e Bioingegneria of Politecnico di Milano, Milano, Italy.

September 2020 – May 2021

Contract professor, course in Computer Science, Civil and Environmental Engineering, Politecnico di Milano, Milano, Italy.

November 2019 – May 2021

Postdoctoral researcher at Dipartimento di Elettronica, Informazione e Bioingegneria of Politecnico di Milano, Milano, Italy.

November 2018 – October 2019

R&D 3D software engineer at Faro Technology, Rezzato (BS), Italy.

October 2017 – October 2018

Postdoctoral researcher at Dipartimento Politecnico di Ingegneria e Architettura of Università degli Studi di Udine, Udine, Italy.

December 2015 – May 2017

Postdoctoral researcher at Dipartimento di Informatica of Università degli Studi di Verona, Verona, Italy.

2013 – 2017

Teaching assistant at Università degli Studi di Milano, Milano, Italy.

January 2013 – June 2013

R&I Intern at ST Microelectronics, Agrate (MB), Italy.

Teaching Activities

2021-2022

- Computer Science (*Professor*) - Civil and Environmental Engineering, Politecnico di Milano - Undergraduate. 8 CFU. (ENG)
- Image Analysis and Computer Vision (*Teaching Assistant*) - Computer Science Engineering, Politecnico di Milano - Undergraduate. (ENG)

2020-2021

- Geometric Computer Vision: from Images to 3D Models (*Professor*) - Doctoral Program in Information and Communication Technology - Department of Information Engineering and Computer, Università di Trento - PhD. 3 CFU - 20h. (ENG)
- Computer Science (*Contract Professor*) - Civil and Environmental Engineering, Politecnico di Milano - Undergraduate. 8 CFU. (ENG)
- Image Analysis and Computer Vision (*Teaching Assistant*) - Computer Science Engineering, Politecnico di Milano - Undergraduate. (ENG)

2017-2018

- Precorso di Matematica for first-year students (*Teaching Assistant*) - Mathematics, Università degli Studi di Milano - Undergraduate.

2014-2015

- Geometria 1 (*Teaching Assistant*) - Physics, Università degli Studi di Milano - Undergraduate.

2013-2014

- Matematica e Statistica (*Teaching Assistant*) - Agricultural and Food Sciences, Università degli Studi di Milano - Undergraduate.

2013-2014

- Fondamenti di Matematica (*Teaching Assistant*) - Natural Sciences, Università degli Studi di Milano - Undergraduate.

2013-2014

- Precorso di Matematica for first year students (*Teaching Assistant*) - Natural Sciences, Università degli Studi di Milano - Undergraduate.

2012-2013

- Geometria 2 (*Teaching Assistant*) - Mathematics, Università degli Studi di Milano - Undergraduate.

2012-2013

- Mentoring for student with disabilities - Servizio Disabili, Università degli Studi di Milano.

Scientific Activities and Services

RESEARCH VISITS

- Invited research visit (January 2020) at the *Applied Algebra and Geometry Group*, Czech Institute of Informatics, Robotics and Cybernetics, Czech Technical University in Prague.

RESEARCH PROJECTS

Cisco Photonics
TYPE: research project
DATE: 2021 - present
TOPIC: Optical Channel Monitoring. Design of robust techniques aimed at channel discovery and methods for the identification of anomalous peaks in OCM spectra
ROLE: *Project leader*

Digitec srl
TYPE: research project
DATE: 2021 - present
TOPIC: 3D calibration for X-ray medical system. Design of a low-cost, fully automated joint calibration for X-Ray–RGB medical imaging system
ROLE: *Project leader*

We-wear
TYPE: research project
DATE: 2021 - present
TOPIC: Calibration and 3D reconstruction for anthropometric landmark extraction
ROLE: *Project leader*

Gilardoni Raggi X
TYPE: research project
DATE: 2019 - 2021
TOPIC: Design of an X-ray baggage-inspection system to meet the new performance standards for airport controls. In particular, the project focuses on machine learning and image-processing algorithms for reducing false alarms.
ROLE: *Principal Investigator*. Design and implementation of algorithms for image segmentation and their integration in efficient software prototypes.
PROJECT LEADER: Prof. Giacomo Boracchi.

3DFlow
TYPE: research project
DATE: 2017 - 2018
TOPIC: Design of algorithms for multi imaging 3D reconstruction.
ROLE: *Principal Investigator*: Designed algorithms for multi-imaging 3D reconstruction and blueprint generation for scan2bim applications. The algorithm for blueprint generation is currently adopted in the stable release of 3DF Zephyr, the main software solution produced by 3DFlow.
PROJECT LEADER: Prof. Andrea Fusiello.

FUND RAISING

Cisco Photonics: Research project , 62K €.
Digitec: Research project , 65K €.
We-wear: Research project , 35K €.
Antares Vision: PhD scholarship, titled "*Synchronization Algorithms and Deep Learning Models for 3D Reconstruction*", Starting November 2021.

Program Committee Member

TPC for the following conferences:

- "*International Joint Conference on Artificial Intelligence - European Conference on AI "*, 2022
- "*1st Whorkshop on Workshop on Traditional Computer Vision in the Age of Deep Learning "*, Workshop at International Conference of Computer Vision 2021.
- "*International Joint Conference on Artificial Intelligence "*, 2021
- "*IEEE International Workshop on Multimedia Signal Processing*", 2020 and 2021.
- "*Photometric Computer Vision Workshop*", Workshop at Conference of Computer Vision and Pattern Recognition, 2019.

Volunteer Services

- Student volunteer at "*International Conference on 3D Vision*", 2018.
- Student volunteer at "*European Conference on Computer Vision*", 2012.

Editorial Activities

Associate Editor

- Associate Editor in The Visual Computer - International Journal of Computer Graphics, Springer, since January 2022.

Guest Editor

- Guest Editor in the Special Issue of selected papers at " *Deep learning model in real life:(Anomaly, Detection, Biomedical, Concept Analysis, Finance, Image analysis, Recommendation)*", Neural Computing and Applications, Springer, 2021.

Refereeing Services

I served as a reviewer for the following international journals:

- IEEE Transactions on Pattern Analysis and Machine Intelligence.
- International Journal of Computer Vision.
- IEEE Transactions on Image Processing.
- ISPRS Journal of Photogrammetry and Remote Sensing.
- Computer Vision and Image Understanding.
- Image and Vision Computing.
- Journal of Real-Time Image Processing.
- IPSJ Transactions on Computer Vision and Applications.

I was a reviewer for the following international conferences:

- "*Eurographics*" in 2022.
- "*IEEE Conference on Computer Vision and Pattern Recognition*", in 2015, 2016, 2018, 2020.
- "*European Conference on Computer Vision*", in 2014, 2016, 2018.

- "*Asian Conference on Computer Vision*", 2018.
- "*International Conference on 3D Vision*", 2015, 2016, 2018.
- "*British Machine Vision Conference*" 2017.
- "*International Conference on Computer Vision*" 2015.

I also served as Emergency reviewer at "*International Conference on 3D Vision*", 2018.

Student Supervision

Supervision of PhD students

- *Andrea Porfiri Dal Cin*, grant titled: "Synchronization Algorithms and Deep Learning Models for 3D Reconstruction". 2021.

Co-supervision of PhD students

- *Antonino Maria Rizzo Leveni*, grant titled: "Anomaly Detection in High-dimensional and Evolving Datastreams". 2021.
- *Filippo Leveni*, grant titled: "Anomaly Detection in High-dimensional and Evolving Datastreams". 2019.

Master Degree Thesis Advisor

- *Diana Isaeva*, ℓ_1-estimation in Computer Vision. MSc in Mathematical Engineering. December 2021, PoliMi.
- *Andrea Porfiri Dal Cin*, Synchronization on Group-labelled Multigraphs. MSc in Computer Science and Engineering. April 2021, PoliMi.
- *Antonino Maria Rizzo* , Semantic aware Sampling for Robust Multi-model Fitting. MSc in Computer Science and Engineering. April 2021, PoliMi.
- *William Bonvini*, Unsupervised Learning for Multi-Model Consensus Maximization. MSc in Computer Science and Engineering. April 2021, PoliMi.
- *Simone Francavilla*, Image Mosaicing: An approach based on Synchronization and Game Theory. MSc in Computer Science and Engineering. April 2021, PoliMi.

Currently supervising:

- *Giuseppe Bertolini* (2021), Topic: Calibration of X-ray system. MSc thesis.
- *Filippo Galli* (2021), Topic: 3D reconstraction of quasi-degenerate scenes. MSc thesis.
- *Enrico Ruggiano* (2021), Topic: Non-rigid model estimation. MSc thesis.
- *Riccardo Nobili* (2021), Topic: Anomaly Detection in Point Clouds. MSc thesis.

Patents

- Yash Singh, Roberto Toldo, Luca MAGRI, Simone Fantoni, and Andrea Fusiello. Method for 3D modelling based on structure from motion processing of sparse 2D images. US Patent App. 10/198,858. Feb. 2019.

- Luca Magri, Beatrice Rossi, Subarna Tripathi, Pasqualina Fragneto, and Emiliano Mario Pic- cinelli. Method for detecting a straight line in a digital image. US Patent 9, 245, 200. 2016.

Talks and Tutorials

TUTORIALS

- "*Inside Plato's door: a tour in multi-view geometry*" accepted at International Conference on Computer Vision and Pattern Recognition (CVPR) 2022.
- "*Multiple Parametric Models Fitting*" at International Conference on Pattern Recognition, International Conference on Pattern Recognition (ICPR) 2020.

TALKS

- "Multiple structure recovery via clustering in preference space" at Czech Technical University, Invited talk, Prague, Czech Republic, January 2020.
- "Multiple structure recovery via clustering in preference space" at Politecnico di Milano, Milano, Italy, December 9, 2019.
- "Multiple structures recovery an application to scan2BIM" at Università degli Studi di Udine, Udine, Italy, May 14, 2018.
- I have presented my work at international conferences:
  - 1 oral [MF15c]
  - 9 poster-presentations [MF14; MF15b; MF16; Mag+17; MT17; MF18b; APM20; AMP20; Lev+20].

Awards and Grants

AWARDS

- "Bundle Block Adjustment with Constrained Relative Orientations" [Mas+20] won the *ISPRS Young Author Award* 2020.

GRANTS AND SCHOLARSHIPS

- *NVIDIA Hardware Grant* donation of an NVIDIA RTX A6000 to support my research on Semantic-aware Sampling for Robust Matching and Pose Estimation. 2021.
- *MIUR Scholarship* to cover PhD studies from November 2013 until November 2015.

Research Statement

My research interests lie at the intersection between Pattern Recognition and Computer Vision. Pattern Recognition deals with the automated discovery of regularities and structures in data and is strictly related with Computer Vision that aims at mimicking human visual abilities and understanding. Within these two

broad streams of research, I focused my activity on unsupervised learning and *3D vision*. The main goal of my research is to bridge the *semantic gap* that separates visual representations from human understanding. Specifically, in my research, I focused on the use of clustering methods to address the problem of *Robust Multiple Structure Recovery* which automatically extracts parametric models from data contaminated by noise and outliers, addressing both theoretical problems and practical applications. My other interests in *3D vision* concern the problem of acquiring 3D models from multiple images, and my major contributions are in the fields of motion segmentation, synchronization problems, photometric stereo, bundle adjustment and the analysis of critical loci for reconstruction.

Robust Multiple Structure Recovery

Finding multiple models (or structures) that fit data corrupted by noise and outliers is an omnipresent problem in empirical sciences, including Pattern Recognition and Computer Vision. In order to derive better interpretations and understanding of noisy observations, data can be organized in higher level structures defined by parametric models. This is a fundamental step, for example, in point cloud segmentation, where an input point clouds is described by fitting multiple geometric primitives such as planes or cylinder, in motion segmentation, where multiple moving objects are detected in a video stream by estimating several 3D motions, and also in time series analysis where a mixture of noisy data streams can be interpreted by different generating mechanisms, just to name few examples.
This challenging problem presents a chicken-and-egg dilemma: in order to estimate models one needs to first segment the data, and in order to segment the data it is necessary to know which structure points belong to. Most of the multi-model fitting techniques proposed in the literature can be divided in two classes, consensus and preference analysis, depending on which horn of the chicken-egg-dilemma is addressed first. Consensus-based methods (as RanSaC) emphasize on the estimation part of the problem and focus on models that describe as many points as possible. On the other side, preference analysis concentrates on the segmentation side and finds the best partition of the data, from which model estimation follows. We were among the first to developed the preference analysis in its full generality by providing a general framework that integrates the use of M-estimator to robustly depict data preferences. In particular, we have investigated three main directions to derive a partition of the data exploiting preferences: agglomerative clustering, divisive clustering and coverage formulations.

- **Agglomerative clustering for multiple structures** In [MF14; MF17b] we investigated the *preference embedding* that lifts data form their ambient space to a high dimensional one, where points are depicted as vectors of preferences granted to a set of models obtained via random sampling. We proposed a continuous relaxation of the preference/no-preference approach implemented by J-linkage, called T-linkage. This approach was further extended in [MF19] to deal with multiple models belonging to multiple classes and in [MLB21] to integrate model selection criteria, further increasing the explanatory power of the preference analysis. In [MF15a] we investigated the preference embedding from a geometrical point of view, and we provided a foundation to the clustering approach, showing that points belonging to the same model are clustered in high density region, whereas outliers can be characterized as the most separated points. We suggested how to exploit this properties to guide random sampling towards promising tentative model hypotheses. We also addressed the problem of defining the best inlier threshold to depict point preferences in [MF15c] and developed a method to automatically select this parameter, avoiding the classical trade-off among data fidelity versus model complexity in favor of a single-term criterion based on consensus clustering.

- **Robust divisive clustering** Following the spectral clustering approach, we studied the connections of the preference embedding with low-rank approximation techniques, which recently sprouted out in Pattern Recognition & Data Mining literature. It is well known that spectral clustering yields accurate

segmentations in two steps: at first, by projecting the data on the space of the first eigenvectors of the Laplacian matrix and then by applying k-means. The shortcoming of this approach is its lack of robustness to outliers. In [MF15b; MF17a] we revisit this scheme to enforce robustness: we replaced the eigen-decomposition step by Robust Principal Component Analysis on a pairwise affinity matrix, and Symmetric Non-Negative Matrix Factorization is used to segment the data in k segments. As a result, we disentangle the chicken-&-egg dilemma by reducing the multi-model fitting problem to many single-fitting problems that can be solved with the help of robust statistics. The resulting algorithm, termed RPA (Robust Preference Analysis), demonstrated to be robust to noise and outliers. The low rank structure of preferences is also exploited in [Den+16], where we took advantage of a bi-clustering formulation to partition simultaneously points and models in a coherent way.

- **Set Coverage formulation** In [MF16; MF18a] we traced the connection between the problem of multi-model fitting and set covering problem. We observed that the pool of tentative models defines a covering of the data whose elements are the consensus sets of the instantiated hypotheses. The problem of estimating models can hence be neatly translated in finding minimal or optimal coverings. Thanks to this formulation we were able to unify several consensus algorithms in a common theoretical framework, termed RanSaCov. We proposed a simple, yet effective, method that generalizes RanSaC to multiple models and deals with intersecting structures and outliers in a straightforward and principled manner, while avoiding the typical shortcomings of sequential approaches and those of clustering.

- **Anomaly detection** The preference embedding has been extended to cope also with anomaly detection problems where the aim is to discard observations that deviate significantly for the rest of the data. In particular, in [Lev+20], we have designed a method able to identify "structured anomalies", *i.e.* points that do not conform to the structure of a local parametric model, and we derived an anomaly scores that leverage on a forest build directly in the preference space achieving superior performances with respect to classical density-based anomaly detection methods.

- **Applications** Our multi model fitting methods, T-linkage [MF14; MF17b], RPA [MF15b; MF17a] and RansaCov [MF16; MF18a] are very versatile and can be applied to a variety of important Computer Vision tasks including: geometric primitive fitting (e.g. line fitting; circle fitting; 3D plane fitting), multi-body segmentation, plane segmentation, and video motion segmentation. For instance, in [MF18b; MMF19] we address the automatic reconstruction of the walls of an interior environment, which is a fundamental step in any "scan2BIM" application. We addressed this task by resorting to an original and improved version of J-Linkage that leverages on the min-Hash technique to boost the efficiency without sacrificing the accuracy.
  A second prominent example of multi-model fitting application is in [AMP20] where a practical motion segmentation algorithm is presented. Motion segmentation refers to the problem of classifying points in multiple images based on the moving objects they belong to. In practice, trajectories along the whole sequences of images are not available, therefore we sidestep this issue by clustering correspondences on triplets of images by fitting trifocal tensors using RPA. This provides a very practical solution to motion segmentation that works successfully under realistic assumptions. In addition, this method has been extended to deal with an unknown number of motions [APM20]. Our preference methods have also proven to be effective data analysis tools outside of computer vision applications: as instance in [Mag+15] our clustering approach is used to perform a cryptographic attack.

3D VISION

My research in 3D vision concerns the automatic extraction of models and measurements from images. Specifically, I have been working on synchronization problems, photometric stereo, registration, bundle

adjustment and critical configurations for 3D reconstruction.

- **Exploiting redundancy in data** Often, in 3D vision problems it is possible to exploit the inherent redundancy of visual data to ensure robust estimates of the quantities of interest. Just to name two relevant applications in *global registration of 3D point sets* the coherence between 3D transformations is an important clue that allows for strong constraints the problem, while in *photometric stereo* the underlying geometry of a scene constraints the intensities values of multiple images captured under different lighting condition. In this context, we investigated and improved two main techniques to exploit the redundancy of multiple measurements: low rank and sparse decomposition and synchronization techniques. Specifically, in [Arr+14] we introduced R-GoDec, a robust low rank and sparse matrix decomposition technique that is used to solve the absolute rotation estimation problem, which arises in global registration and in structure-from-motion. We formulated a novel cost function which inherently copes with data corruption, handling both outlier and missing relative rotations. The same low rank formulation has proved effective for the photometric stereo problem: which consists in recovering surface normals of an object given several images acquired under different lighting conditions. In [Mag+17] we revisited calibrated Lambertian photometric stereo as a robust low-rank matrix recovery problem with both missing and corrupted entries and we integrated R-GoDec in a normal surface estimation algorithm able to cope with shadows and specular reflections. The problem of synchronizing multiple rotations has been generalized and investigate also in [Por+21], where, for the first time in the literature, we explicitly addressed the problem of synchronizing transformation on multi-graph, *i.e.,* multiple transformations exist between the same pairs of states. We derived a practical closed-form solution that enables to tackle large-scale problems trading a small loss in accuracy for shorter execution times.

- **Bundle Adjustment** In 3D reconstruction bundle adjustment is a non-linear minimization procedure that adjusts points and cameras by minimizing the reprojection error of points. This step is performed at the end of each of Structure From Motion pipeline to ensure accurate results.
  In [MT17] we investigated how geometric constraints can be integrated in a bundle adjustment framework to mitigate the so-called "doming effect", a phenomenon that disrupts the quality of the attained 3D reconstruction. In [Mas+20] we considered the case of bundle adjustment with constrained cameras, i.e. where the orientation of certain cameras is expressed relatively to others, and these relative orientations are part of the unknowns. In particular, we studied the effect of enforcing relative orientation constraints in bundle adjustment. We provided experimental evidence that these constraints improve the accuracy of the results, while reducing the computational burden as well. We reported for the first time in the literature the complete derivation of the Jacobian matrix for bundle adjustment with constrained cameras.

- **Critical loci for 3D reconstruction** A classical problem in Computer Vision is projective reconstruction: given sufficiently many images of an unknown scene, taken from uncalibrated cameras, the aim is to reconstruct the positions of cameras together with the position of scene points, up to a projective transformation. When sufficiently many corresponding points in general positions in the two views are available, a projective reconstruction can be obtained. However, particular configurations of points and cameras exist that prevent a unique reconstruction: i.e., there are non- projectively equivalent pairs of sets of points and cameras that produce the very same images in the view planes. We have studied these "*critical loci*" using algebraic geometry theory [BM20]. Specifically, in [BMT19] we demonstrated that corresponding points which are images of critical points are linked by a birational map between the two images which is a quadratic transformation. This transformation is explicitly described and used to investigate the instability phenomena for reconstruction.

FUTURE DIRECTIONS

Multi-body 3D reconstruction. 3D reconstruction (and specifically Structure from Motion - SfM) is a mature technology that has been successfully applied in a wide range of applications. However, SfM is currently based on the assumption that the scene to be reconstructed is static (single-body assumption). This is restrictive since the physical reality is characterized by multiple moving entities. It is also impractical, as the scene must remain unchanged throughout the whole acquisition, and suboptimal, as the image content that does not conform with the single-body assumption must be discarded. In addition, the single-body assumption limits the fruition of the 3D model, which is an isolated object outside of its context. This research direction I currently investigating aims to overcome the single-body assumption to unleash the full potential of SfM by reconstructing dynamic scenes. Specifically, the focus is on the multi-body SfM problem: given an unorganized set of images of a scene composed of multiple moving rigid objects acquired from uncalibrated and unknown cameras, retrieve the 3D structure of the scene, the position of the cameras, and the 3D motions of the objects.

Geometric estimation and learned models. On the one hand, geometric models, *i.e.*, analytical expressions involving few parameters with a geometric interpretation, successfully capture precise metrological information. However they are not flexible enough to describe arbitrary-shaped structures and can not encode directly higher-level semantic information which is very relevant in vision applications. On the other hand, learned "neural models" used in Deep Learning, are flexible and can describe arbitrary complex patterns, but lacks the robustness and the stability required in geometric estimation. These drawbacks are confirmed by the fact that end-to-end deep-learning solutions aimed at solving classical geometric Computer Vision problems (such as image matching, camera pose, 3D reconstruction) work well only on small datasets, are unstable and do not generalize well with respect to viewpoint and illumination changes. Although, strictly speaking, neural models can be considered parametric models as the geometric ones, unfortunately, the exorbitant number of parameters involved does not allow to use them straightforwardly inside geometric robust estimators. The research challenge I would like to address is to study novel algorithmic paradigms that combine geometric estimation and learned model to achieve robustness, metrology accuracy together with high-level semantic interpretability.

Complete list of publications

PUBLICATION LIST

BIBLIOMETRY

FROM GOOGLE SCHOLAR (QUERY DATE: 2022-03-31)

- Citations (all): 425; h-index: 7; i10-index: 7
- Citations (since 2017): 366; H-index: 7; i10-index: 7

FROM SCOPUS (QUERY DATE: 2022-03-31)

- Documents: 23
- Citations: 237

- h-index: 6

Referred International Journals

[BM20] Marina Bertolini and Luca Magri. "Critical hypersurfaces and instability for reconstruction of scenes in high dimensional projective spaces". In: *Machine GRAPHICS & VISION* 29.1/4 (2020).

[BMT19] Marina Bertolini, Luca Magri, and Cristina Turrini. "Critical Loci for two views reconstruction as quadratic transformations between images". In: *Journal of Mathematical Imaging and Vision* (2019). URL: https://doi.org/10.1007/s10851-019-00908-w.

[MF18a] Luca Magri and Andrea Fusiello. "Multiple structure recovery with maximum coverage". In: *Machine Vision and Applications* 29.1 (2018). URL: https://doi.org/10.1007/s00138-017-0883-x.

[MF17a] Luca Magri and Andrea Fusiello. "Multiple structure recovery via robust preference analysis". In: *Image and Vision Computing* 67 (2017). URL: https://doi.org/10.1016/j.imavis.2017.09.005.

[MF17b] Luca Magri and Andrea Fusiello. "Multiple structure recovery with T-linkage". In: *Journal of Visual Communication and Image Representation* 49 (2017). URL: http://dx.doi.org/10.1016/j.jvcir.2017.08.005.

Referred International Conferences

[MLB21] Luca Magri, Filippo Leveni, and Giacomo Boracchi. "MultiLink: Multi-class Structure Recovery via Agglomerative Clustering and Model Selection". In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2021. DOI: 10.1109/CVPR46437.2021.00189.

[Por+21] Andrea Porfiri Dal Cin, Luca Magri, Federica Arrigoni, Andrea Fusiello, and Giacomo Boracchi. "Synchronization of Group-labelled Multi-graphs". In: *Proceedings of the International Conference on Computer Vision*. 2021. DOI: 10.1109/ICCV48922.2021.00639.

[AMP20] Federica Arrigoni, Luca Magri, and Tomas Padja. "On the Usage of the Trifocal Tensor in Motion Segmentation". In: *Proceedings of the European Conference on Computer Vision*. 2020. URL: https://doi.org/10.1007/978-3-030-58565-5_31.

[APM20] Federica Arrigoni, Tomas Padja, and Luca Magri. "Motion segmentation with pairwise matches and unknown number of motions". In: *Proceedings of the International Conference on Pattern Recognition*. 2020. DOI: doi:10.1109/ICPR48806.2021.9413142..

[Lev+20] Filippo Leveni, Luca Magri, Giacomo Boracchi, and Cesare Alippi. "Pif: anomaly detection via Preference Embedding". In: *Proceedings of the International Conference on Pattern Recognition*. 2020. DOI: 10.1109/ICPR48806.2021.9412658.

[Mas+20] Eleonora Maset, Luca Magri, Isabella Toschi, and Andrea Fusiello. "Bundle Block Adjustment with Constrained Relative Orientations". In: *Proceedings of the XXIV ISPRS Congress*. 2020. DOI: 10.5194/isprs-annals-V-2-2020-49-2020.

[MF19] Luca Magri and Andrea Fusiello. "Fitting Multiple Heterogeneous Models by Multi-Class Cascaded T-Linkage". In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2019. DOI: 10.1109/CVPR.2019.00764.

[MMF19] E Maset, L Magri, and A Fusiello. "Improving Automatic Reconstruction of Interior Walls from Point Cloud Data". In: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Vol. 42. 2/W13. 2019. DOI: 10.5194/isprs-archives-XLII-2-W13-849-2019.

[MF18b] Luca Magri and Andrea Fusiello. “Reconstruction of interior walls from point cloud data with min-hashed J-linkage”. In: *Proceedins of the International Conference on 3D Vision*. 2018. DOI: 10.1109/3DV.2018.00025.

[MT17] Luca Magri and Roberto Toldo. “Bending the doming effect in structure from motion reconstructions through bundle adjustment”. In: *The International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*. Vol. 42. 2017.

[Mag+17] Luca Magri, Roberto Toldo, Umberto Castellani, and Andrea Fusiello. “A Matrix Decomposition Perspective on Calibrated Photometric Stereo”. In: *Proceedings of the International Conference on Image Analysis and Processing*. 2017. URL: https://doi.org/10.1007/978-3-319-68560-1_45.

[Den+16] Matteo Denitto, Luca Magri, Alessandro Farinelli, Andrea Fusiello, and Manuele Bicego. “Multiple structure recovery via probabilistic biclustering”. In: *Joint IAPR International Workshops on Statistical Techniques in Pattern Recognition and Structural and Syntactic Pattern Recognition*. 2016. URL: https://doi.org/10.1007/978-3-319-49055-7_25.

[MF16] Luca Magri and Andrea Fusiello. “Multiple model fitting as a set coverage problem”. In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2016, pp. 3318–3326. DOI: 10.1109/CVPR.2016.361.

[MF15a] Luca Magri and Andrea Fusiello. “Fitting Multiple Models via Density Analysis in Tanimoto Space”. In: *Proceedings of the International Conference on Image Analysis and Processing*. 2015. DOI: 10.1007/978-3-319-23231-7_7.

[MF15b] Luca Magri and Andrea Fusiello. “Robust Multiple Model Fitting with Preference Analysis and Low-rank Approximation”. In: *British Machine Vision Conference*. Vol. 20. 1-20. 2015. URL: https://dx.doi.org/10.5244/C.29.20.

[MF15c] Luca Magri and Andrea Fusiello. “Scale estimation in multiple models fitting via Consensus Clustering”. In: *Proceedings of the International Conference on Computer Analysis of Images and Patterns*. 2015. DOI: 10.1007/978-3-319-23117-4_2.

[Mag+15] Luca Magri, Silvia Mella, Pasqualina Fragneto, Filippo Melzani, and Beatrice Rossi. “J-DFA: A Novel Approach for Robust Differential Fault Analysis”. In: *Workshop on Fault Diagnosis and Tolerance in Cryptography*. 2015. DOI: 10.1109/FDTC.2015.14.

[Arr+14] Federica Arrigoni, Luca Magri, Beatrice Rossi, Pasqualina Fragneto, and Andrea Fusiello. “Robust absolute rotation estimation via low-rank and sparse matrix decomposition”. In: *Proceedings of the International Conference on 3D Vision*. Vol. 1. 2014. URL: https://doi.org/10.1109/3DV.2014.48.

[MF14] Luca Magri and Andrea Fusiello. “T-linkage: A continuous relaxation of j-linkage for multi-model fitting”. In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2014. URL: https://doi.org/10.1109/CVPR.2014.505.

[Fra+12] Pasqualina Fragneto, Andrea Fusiello, Beatrice Rossi, Luca Magri, and Matteo Ruffini. “Uncalibrated view synthesis with homography interpolation”. In: *Proceedings of the IEEE Conference on 3D Imaging, Modeling, Processing, Visualization and Transmission*. 2012. URL: https://doi.org/10.1109/3DIMPVT.2012.39.

International Patents

[Sin+19] Yash Singh, Roberto Toldo, Luca MAGRI, Simone Fantoni, and Andrea Fusiello. *Method for 3D modelling based on structure from motion processing of sparse 2D images*. Feb. 2019.

[Mag+16] Luca Magri, Beatrice Rossi, Subarna Tripathi, Pasqualina Fragneto, and Emiliano Mario Piccinelli. *Method for detecting a straight line in a digital image*. 2016.

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