

PERSONAL INFORMATION

Raffaella Brumana

📍 Office address: Politecnico Milano, Dept. ABC (Department of Architecture, Built Environment and Construction Engineering), Building 15, Room P201, Via Ponzio 31, 20133 Milan (ITALY)

POSITION

Full Professor (Geomatics)

WORK EXPERIENCE

07/01/2016–Present

Full Professor (Class 08/04 Geomatics) - Politecnico di Milano

2008 –present: Politecnico Milano - Department of Architecture, Built environment and Construction engineering (DABC), Milano, Italy, Milan (Italy)

- Professor of Innovative Advanced Surveying techniques, Surveying&Modelling Techniques at the M.Sc.Arch and Ms.Building Engineering/Architecture (**AUIC** - School of Architecture - Urban Planning - Construction Engineering, **7th position in the Int. QS University Ranking 2020**)
- Board Member - Post-Graduate School in Architectural and Landscape heritage SSBAP (1996-2020)
- Member of the Scientific Board of the POLIMI School of DABC Doctoral Studies (2009-2018)
- 2000-2008 (DIIAR Department of Engineering - Hydraulics, Environment and Surveying) - Coordinator of the Scientific Commission for the Surveying Unit.

Research activities

Main research activities expertise:

Surveying, Heritage Building Information Model, BIM-GIS modelling processing, data management, data fruition, Spatial Data Infrastructure, Geospatial and XR platform in the domain of Architectural Heritage, Built Environment, Landscape, Archaeological and Historical Site, Virtual Museums.

- multi-resolution multi-scale- multi-temporal data acquisition (LIDAR, Laser scanning, TLS, MMS GEOSLAM, 3D Photogrammetry-SfM Structure for Motion, massive mobile fast photogrammetry – spheric cameras), multi-spectral (RGB, Thermal Infrared IRT, NIR, HyperSpectral) images from different platforms (UAV/ground/on-site/satellite/Copernicus).
- eXtended Reality platform implementation, XR (AR-MR-VR); Applications implementation (Androids and IOS); GEOPAN APP.
- Human centric interactive XR reconnecting 3D data sources and informative models for experts, operators and fruitors communities (Interactive Virtual Museum/VR/AR/MR, application on historical sites, archeological parks, lake landscape, front view, Museum Collections).
- 4D HBIM Heritage Building Information Model&management of monuments. SCANtoBIM data processing; HBIM enabling complex model data management. Grade of Generation from simplex to complex (GOG1-10).
- HBIM repertoires and object libraries of architectural components (facades, walls, covers, vaults, domes, ceilings, decorative components as freascos, stuccos): generation, knowledge creation, knowledge sharing; Data formats interoperability : BIM modelling Data interoperability HBIM-IFC2x3, IFC4.
- HBIM re-use and remote accessibility and sharing: specifications and protocols implementation of different LODs (Level of Details), LOGs (Level of Geometry), LOA (Level of Accuracy), LOI (Level of Information). From complex to simple reverse logic to manage Cultural Heritage complexity respect to BIM (Building and Infrastructure new construction).
- n-D multi-scale-modelling and monitoring in complex scenarios, complex Object Recognition-Reconstruction (ORR); pure modeling and parametric modeling; generative modeling; mesh to NURBSto mesh interoperability and decimation;
- HBIM addressing for the different uses (BIMtoFEA, Energy Efficiency Data management, Preservation Plan, Materials Construction Techniques and Decay and costs computation-Work Breakdown Structure –WBS HBIM enabled).
- HBIM-GEOSPATIAL WEB services platform implementation (HBIM Vault Libraries nodes within Geospatial platform). WEB GIS, BIM-GIS OpenData, GEODB HUB linked HBIM, SDI

(Spatial Data Infrastructure). Geocustering for Building District Urban Environmental.

- Common Data Environment co-working cooperative platform implementation.
- Virtual Hub Discovery Access Brokering System based on Open Data (Temporal and Spatial Tile subsetting). Multi-temporal map series (historical map archives collections, data registry), Geographic Open Data (GOD), Linked Data, Linked BIM data, LODLAM
- Digital twins under threats (as land degradation /flooding): SCAN-to-BIM-to-XR supporting VR/MR/AR; informative models, BIM-GIS integration, IOT-sensors, real time data sharing with the support of Mixed Reality applied to multi-dimension Cultural Heritage domain; algorithms implementation, deep learning applied to Historical and Archeological Sites recognizing recurrent permanencies and mutation pattern analysis: image detection, change detection techniques to identify the transformation and comparison across the time.
- Land Degradation of Landscape and Remote Rural Areas integrating Copernicus programme with ground validation, implementing Medalus indicators, Learning by Living Labs for social and community engagement rising awareness;
- Learning by living Labs and Social Engagement through XR platforms, Geoinformation data processing and management for the Societal Benefit Areas.

Sc. Resp. GICARUS ABCLab

01/01/2004 - 2008 Scientific Responsible of eSITECH lab – (Department DIAR=

01/01/2008 - Present Scientific Responsible of **Gicarus ABCLab (4D BIM - GIS - SDI - XR)**

Geospatial Information & Content modeling: Architectural heritage and built environment, eXtended Reality, eUrbanAtl@s, Surveying, Modeling and Monitoring (Department ABC)

Politecnico di Milano, Via Ponzio 31, 20133 Milan (Italy)

Gicarus Surveying, Modelling, IOT, XR - Via Ponzio, 31 20133 - Milan, Italy (Ph. +39 02 2399 6513)

Gicarus Surveying and Monitoring - Via Previati 1/c, 23900 - Lecco, Italy (Ph. +39 02 2399 8778)

<http://www.gicaruslab-abc.it>

<http://www.gicarus.polimi.it>

01/09/2001–06/01/2016

Associate Professor

Politecnico Milano - Department of Architecture, Built environment and Construction engineering (DABC), Milano, Italy, Milan (Italy)

- Since 2000, **Board Member, Post-Graduate School** (SBAP-Scuola di Specializzazione in Beni Architettonici e Paesaggio), Teaching of Applied Photogrammetry.
- Since 2006, **Board Member, Research Doctorate programme**, for Ph.D. students in Geodesy and Geomatics (5 credits), GIS for cultural Heritage.

16/10/1995–31/08/2001

Assistant Professor (Class 08/04 Geomatics)

Politecnico di Milano - Dept. of Hydraulic, Environmental, Surveying and Infrastructure Engineering, Milan (Italy)

EDUCATION AND TRAINING

1989–1993

PhD on Geodetic and Topographic Sciences - (cycle V 1989-1992)

Politecnico di Milano - Dept. of Hydraulic, Environmental, Surveying and Infrastructure Engineering, Milan (Italy)

PhD Dissertation: 'Metodologie e tecniche avanzate di rappresentazione nel rilevamento del patrimonio architettonico'. Advanced Methodologies and Techniques of Heritage Documentation

1983–1988

MSc on Architecture (5 years programme) - with Honour

Politecnico di Milano - Faculty of Architecture

1977–1982

High School Humanistic Maturity (Liceo Classico) - Ancient Greek

PERSONAL SKILLS

Mother tongue(s) Italian

Foreign language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
	C2				
Greek	A1				

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
 Common European Framework of Reference for Languages - Self-assessment grid

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem-solving
Proficient user	Proficient user	Proficient user		

Digital skills - Self-assessment grid

ADDITIONAL INFORMATION

Editorial activities

Editor / Co-Editor / Associate Editor/ Guest Editor

- Lerma, Brumana, Tucci, Lerma (Eds), 2021, ARQUEOLÓGICA 2.0 - 9th International Congress & 3rd GEORES - GEomatics and pREServation, pp. 325-334. Editorial Universitat Politècnica de València; [Proceedings of ARQUEOLÓGICA 2.0 & GEORES – 2021](#)
- **SI Applied Geomatics 2022, Guest Editor, SI- SPECIAL ISSUE “GEORES: HBIM AS PART OF A CO-WORKING GEOSPATIAL ECOSYSTEM”** Article DOI: 10.1007/s12518-021-00408-w, Editorial manuscript number: SI_HBIM_GeoSpatial_ecosystem;
- Brumana, Tucci, Lerma (Eds), 2019, **Special Issue: Informative Models and Systems for Virtual Museums**. In: Virtual Archaeology Review, 10(21): 2019, pp.1-131, <https://polipapers.upv.es/index.php/var/issue/view/908/showToc>
- Brumana, R., Pracchi, V., Rinaudo, F., Grimoldi, A., Scaioni, M., Cantini, L., and Previtali, M. (Eds). GEORES2019. **Geomatics and restoration. Cultural heritage: challenges, new perspectives and technology innovation. Toward informative content models and beyond**, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLII-2/W11, <https://doi.org/10.5194/isprs-archives-XLII-2-W11-1-2019>, 2019, pp.1-1198, <https://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XLII-2-W11/>.
- Ioannides, M., Fink, E., Brumana, R., Patias, P., Doulamis, A., Martins, J., Wallace, M. (Eds.). **Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection**, EuroMed 2018, Nicosia, Cyprus, Proceedings, LNCS 11196 and LNCS 11197. Springer.

Peer reviewer for the following journals:

- Journal of Cultural Heritage (ISSN: 1296-2074)
- Virtual Archaeology Review (ISSN 19899947) – SCOPUS INDEXED
- Cipa Ottawa 2017 – 26th International Symposium on Digital Workflows for Heritage Conservation
- Euromed 2018 Digital Heritage - Euromed 2018 - International Conference on Digital Heritage focusing on Documentation, Preservation and Protection.
- GEORES 2019 - 2nd International Conference of Geomatics and Restoration ISPRS WG II/8, WG III/5, WG V/1

Steering committee, International Committee, Advisory Board

- 2017-on course, **Partnership Board Member** of the **EU ECTP platform** - Public Private Partnership (PB ECTP EEB PPP)
- 2018-on course **ERA-CHAIR Advisory Board** and **Expert Member of the European Research Area (ERA) Chairs on Digital Heritage** (CUT, Cyprus)
- 2017- on course **Copernicus Academy Member**– Network Selection (Copernicus Academy Network Applicant Call for expression of interest to join the Copernicus Academy Network) – DG GROW, Space Data for Societal Challenges and Growth
- 2017-2019 Advisory Board Member - H2020 (CSA H2020) **VIMM Virtual MultiModal Museum** (CUT Cyprus)
- 2012-14, member of the **E2BA STEERING COMMITTEE**
- 2015-16 SCIENTIFIC COUNCIL E2BA (Energy Efficient Building Association)

Conferences

Organization of Scientific events and International Conferences

- ARQUEOLÓGICA 2.0 - 9th International Congress & 3rd GEORES - GEOmatics and pREServation , (Valencia, 26-28 April, 2021) - **Co-chair**
- GEORES2019 (**Chair**) - 2nd Int. Conf. of 'Geomatics and Restoration', Milan 8-10 May 2019 (ISPRS and CIPA-ICOMOS event)
- EUROMED2018 - **Co-chair**
- 2017 CIPA Ottawa 2017 26th International Symposium (ICOMOS and ISPRS), Member of the Scientific Board (double peer review process management [Conference Software - ConfTool Pro 2.6.106+TC](#) © 2001 - 2017 by H. Weinreich, Hamburg, Germany <https://www.conftool.pro/cipaottawa/>).

Memberships

International Collaboration, roles in scientific and technical committees, Ws organization:

- Since 2010 she collaborates as Polimi Associate Member of Lombardy Region within **NEREUS (Network of the EU Regions for Using Space technologies)**, WGs GMES and CET Programme, to performs scientific and technologic research for Space GMES services development devoted to downstream services deployment.
- 2017-on course (**PB ECTP EEB PPP Public Private Partnership**) and ECTP-E2BA WG Infrastructure, 2012-16, E2BA Steering Committee, Raffaella Brumana;
- 2012-14, member of the STEERING COMMITTEE, 2015 SCIENTIFIC COUNCIL E2BA (Energy Efficient Building Association, PPP), of the E2B EI, **Energy Efficient Building European Initiative (Eu2020 objectives, Horizon2020 Challenge, Decarbonization2050)**, supported by GI, BIM-EM-GIS.
- RSCY2014-15 Member of the international committee of the International Conference On Remote Sensing and Geo-Information of The Environment <http://www.cyprusremotesensing.com/rscy2015/> (proceedings published by SPIE Eds).
- ASITA2015 (29-30-1 Oct, Lecco IT) - Member of the Organizer Hosting Committee of the XIX National Conference and Scientific Responsible of the WS BIM Special Session.
- Scientific Responsible of the Conference 'Il portale Atl@nte e i catasti storici' for the presentation of the Open Source Geoportal multi-temporal map series www.atlas.polimi.it (Cariplo Foundation), 14-05-2012, Milano.
- 2006-09, International Scientific Board of UNESCO-OPEN FORUM Mesopotam Saranda (Albania), SR of the surveying campaign (2006-09 with Univ. Ca' Foscari, Koc University, Istanbul).
- ICOMOS Member (International Council on Monuments and Sites).

Honours and awards

European Heritage Award/Europa Nostra Award 2020: Il "Premio Europeo del Patrimonio 2020". Restauro premiato con il European Heritage Award/Europa Nostra Award 2020: Il "Premio Europeo del Patrimonio 2020".

Contribution SDI_HBIM: from surveying to object modeling to support the documentation, project and management of the architectural heritage (Sc. Resp R. Brumana) within the Project "Ripartire da Collemaggio" Coord. Prof. S. Della Torre, Funded by ENIservizi.

Best Paper Award

GEORES 2019 - 2nd International Conference of Geomatics and Restoration

For the paper: Banfi, F., Brumana, R., & Stanga, C. (2019). A Content-Based Immersive Experience of Basilica of SANT'AMBROGIO in Milan: from 3d Survey to Virtual Reality. ISPRS-International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 4211, 159-166.

· **The Werner Weber award - Best Full paper EUROMED 2016**

EuroMed 2016 Euromed Digital heritage: progress in cultural heritage documentation, preservation and protection

For the paper: Barazzetti, L., Banfi, F., & Brumana, R. (2016, October). Historic BIM in the Cloud. In Euro-Mediterranean Conference (pp. 104-115). Springer, Cham.

· **17° MEDIARC Festival Internazionale di Architettura in Video – 2° Premio**

For the video: Ponte Azzone Visconti – Campagna di rilevamento e modello BIM (Building Information Modelling) *Glicarus Lab (4D BIM – HBIM – WEBGIS – SDI) Geospatial Information Content Modelling: Architectural heritage&built environment, eUrbanAtlas, data Surveying*

Courses & teaching activities

Official lecturer at Politecnico Milano:

Courses held in the last 5 years at the School of Architecture - Urban Planning - Construction Engineering – AUIC (Scuola di Architettura Urbanistica Ingegneria delle Costruzioni), 9th position in the Int. QS University Ranking 2018, 11th 2018, 7th 2019

- **AA 2015/2020** Arc - Urb - Cost (Mag.)(ord. 270) - MI (1195) ARCHITETTURA - AMBIENTE COSTRUITO - INTERNI - ARCHITECTURE - BUILT ENVIRONMENT – INTERIORS

051566 - ARCHITECTURAL PRESERVATION STUDIO

051568 - ADVANCED SURVEY AND REPRESENTATION TECHNIQUES (4cfu)

- **AA 2017/18 - Arc - Urb - Cost (Quinq.)(ord. 270) - LC (1144) INGEGNERIA EDILE - ARCHITETTURA**

099698 - DISEGNO DELL'ARCHITETTURA 2 + LABORATORIO DI RILIEVO FOTOGRAMMETRICO DELL'ARCHITETTURA

099705 - DISEGNO DELL'ARCHITETTURA 2 (DISEGNO) – Topografia (3cfu)

99704 – LABORATORIO DI RILIEVO FOTOGRAMMETRICO DELL'ARCHITETTURA (3CFu)

- **AA 2015/2020, Arc - Urb - Cost (Mag.)(ord. 270) - MI (1217) ARCHITETTURA E DISEGNO URBANO - ARCHITECTURE AND URBAN DESIGN**

051502 - LABORATORIO DI RESTAURO

051504 - TECNICHE INNOVATIVE DEL RILEVAMENTO (4cfu)

- **AA 2017/18, Arc - Urb - Cost (1 liv.)(ord. 270) - MI (1094) PROGETTAZIONE DELL'ARCHITETTURA**

097304 - LABORATORIO DI PROGETTAZIONE ARCHITETTONICA 2

097331 - TOPOGRAFIA E RILEVAMENTO (4cfu)

- **AA 2016/2017, Arc - Urb - Cost (Quinq.)(ord. 270) - LC (1144) INGEGNERIA EDILE - ARCHITETTURA**

099698 - DISEGNO DELL'ARCHITETTURA 2 + LABORATORIO DI RILIEVO FOTOGRAMMETRICO DELL'ARCHITETTURA

- **099705 - DISEGNO DELL'ARCHITETTURA 2 (DISEGNO) – Topografia (3cfu)**

- **99704 – LABORATORIO DI RILIEVO FOTOGRAMMETRICO DELL'ARCHITETTURA (3CFu)**

Arc - Urb - Cost (1 liv.)(ord. 270) - MI (1094) PROGETTAZIONE DELL'ARCHITETTURA

097304 - LABORATORIO DI PROGETTAZIONE ARCHITETTONICA 2

097331 - TOPOGRAFIA E RILEVAMENTO (4cfu)

Arc - Urb - Cost (Mag.)(ord. 270) - MI (1136) ARCHITETTURA

093333 - LABORATORIO DI RESTAURO ARCHITETTONICO

091446 - TECNICHE INNOVATIVE DEL RILEVAMENTO (4cfu)**AA 2015/2016**

Arc - Urb - Cost (Quinq.)(ord. 270) - LC (1144) INGEGNERIA EDILE - ARCHITETTURA
083568 - DISEGNO DELL'ARCHITETTURA 2 + LABORATORIO DI RILIEVO
FOTOGRAMMETRICO DELL'ARCHITETTURA

- 083566 - DISEGNO DELL'ARCHITETTURA 2 (DISEGNO) – Topografia (3cfu)

Arc - Urb - Cost (1 liv.)(ord. 270) - MI (1094) PROGETTAZIONE DELL'ARCHITETTURA
097304 - LABORATORIO DI PROGETTAZIONE ARCHITETTONICA 2

097331 - TOPOGRAFIA E RILEVAMENTO (4cfu)

Arc - Urb - Cost (Mag.)(ord. 270) - MI (1136) ARCHITETTURA
093333 - LABORATORIO DI RESTAURO ARCHITETTONICO

091446 - TECNICHE INNOVATIVE DEL RILEVAMENTO (4cfu)

Arc - Urb - Cost (Mag.)(ord. 270) - MI (1136) ARCHITETTURA
093384 - ARCHITECTURAL PRESERVATION STUDIO

- 093420 - SURVEY ADVANCED TECHNIQUES**Courses held at the Doctoral School :****- Dott. - MI (1367) BUILT ENVIRONMENT AND CONSTRUCTION ENGINEERING**

099065 - CULTURAL HERITAGE AND BUILT ENVIRONMENT SURVEYING, MODELLING AND
MONITORING (R. Brumana) "Multi-Temporal, Multi-Source, Multi-Scale Remote Sensing Data
for Built Environment, Cultural and Archaeological Heritage" (5 cfu)

- Courses held at the Master post Master School :

- AA. 2011/12, 2013/14 2015/16, 2017/18, 2018-2020 Scuola SSBAP Scuola di
Specializzazione in Beni Architettonici e Paesaggio - Advanced Surveying Techniques
- Tecniche avanzate di Rilevamento**

International Workshops and Internship programmes

- Internship programmes:** 2016-2020 Polimi Scientific responsible and Executive Committee Member of Partnered Research Training Initiative 'New Paradigm / New Tools', Canada SSHRC (Social Sciences and Humanities Research Council, Canadian Government, Partnership Grants - Partnered Research Training Initiative Program).
- 10-14/01/2011, KUL Leuven RLICC Be, 10thWS ARCHDOC (Architectural Heritage Documentation for Conservation), "Partnership in Learning, a training course designed for graduate students of Conservation and RLICC MANAMA (Unesco Chair on Preventive conservation of monuments and Sites, Master After Master in Conservation of Monuments and Sites). R. Brumana: Guest Lecturer on Heritage recording and Training Group Coordination providing practicum sessions about Historic Building's metric survey- 40hours; from 10-01-2011 to 14-01- 2011**
- 14-19/11/2011, KUL Leuven RLICC Be, 11thWS ARCHDOC (Architectural Heritage Documentation for Conservation), "Partnership in Learning, a training course designed for graduate students of Conservation" and RLICC MANAMA (Unesco Chair on Preventive conservation of monuments and Sites, Master After Master in Conservation of Monuments and Sites). R. Brumana: Guest Lecturer on Heritage recording and Training Group Coordination providing practicum sessions about Historic Building's metric survey - 40 hours ; from 14-11-2011 to 19-11- 2011 03-07/12/2012, KUL Leuven RLICC Be, invitata al 12thWS ARCHDOC (Architectural Heritage**
- 14-19/11/2011, KUL Leuven RLICC Be, 12thWS ARCHDOC (Architectural Heritage Documentation for Conservation), "Partnership in Learning, a training course designed for graduate students of Conservation" and RLICC MANAMA (Unesco Chair on Preventive conservation of monuments and Sites, Master After Master in Conservation of Monuments and Sites). R. Brumana: Guest Lecturer on Heritage recording and Training Group Coordination providing practicum sessions about Historic**

Building's metric survey - 40 hours ; ERASMUS Teaching Staff Mobility,; from 03-12-2012 to 07-12-2012

- 08-12/12/2014, KUL Leuven RLICC Be, invitata al **14thWS ARCHDOC** (Architectural Heritage Documentation for Conservation), ERASMUS Teaching Staff Mobility, "Partnership in Learning, a Conservation and RLICC MANAMA (Unesco Chair on Preventive conservation of monuments and Sites, Master After Master in Conservation of Monuments and Sites)- 40 hours; from 08-12-2014 to 12-12-2014 training course designed for graduate students
- 16-20/11/2015, KUL Leuven RLICC Be, invitata al **15thWS ARCHDOC** (Architectural Heritage Documentation for Conservation), ERASMUS Teaching Staff Mobility, "Partnership in Learning, a training course designed for graduate students of Conservation and RLICC MANAMA (Unesco Chair on Preventive conservation of monuments and Sites, Master After Master in Conservation of Monuments and Sites)- 40 hours; from 16-11-2015 to 20-11-2015
- 2013 and 2014 **FORMAT EO** (FORmation of Multi-disciplinary Approaches to Training in Earth Observation), **Funded ERASMUS IP**, University of Leicester, UK.

Projects

Scientific Responsible, PI (Principle Investigator) of international European and IT funded projects:

2020-2021 **"Study on standards, methodologies and guidelines for 3D digitisation of cultural heritage"** - VIGIE-2020/654, Tender EC, (POLIMI Expert Member - Third Party, RB Sc. Responsible for 3D quality models of un-movables).

2020-2018 **ALDREN** - Alliance for Deep RENovation in buildings Implementing the European Common Voluntary Certification Scheme, as back-bone along the whole deep renovation process (**H2020-EE-2016-CSA**). Contribution to the project.

2014-2017, **ENERGIC-OD** 620400, **European Network for Redistributing Geospatial Information to user Communities - Open Data** (Head CNR-IIA) CIP-ICT-PSP-13-7Theme 2 - Digital content, OD creativity. Polimi R. Brumana, in charge for GEOPANAPP implementation, Multisource OD-GOD access&semantic profiling. POLIMI PI. Awarded by the EC-ICT Radar Innovation.

2012-2014, FP7-2011-NMP-ENV-ENERGY-ICT, GE2O, "Geo-clustering to deploy the potential of EEB across EU" (Head: **CSTB, R. Brumana Polimi**) **GA 285501, 1-31-2012. Open source geoportal Data Access**). POLIMI PI, in charge for UAV-RGB-IRT-Scan-to-BIM-on site- automation, BIM User Planner Tool of precast structural panels for retrofitting and energy efficiency, controlled high precision installation of anchors and panels without scaffolding. Awarded as one the best projects (EC2017, Bruxelles).

EASEE (2011-13), FP7 Large scale project (R. Brumana Sc. Resp Polimi in charge for BIM User Planner Tool, Surveying to BIM automation). POLIMI Scientific Coordinator and Programme Manager

FESR HomeBIM 2017-2019 (Sc. Res. POLIMI); 2017-2019 **"HOMeBIM liveAPP: VR multi-user Live APP BIM-sensor integration – ID 379270"** "Smart Living:" approvato con d.d.u.o. n.11672 dell'15 novembre 2016 per la presentazione di progetti di sviluppo sperimentale e innovazione (S&I) a favore della filiera dello "Smart Living". POLIMI PI. *APP implementation for the visualization of monitoring data on 3DBIM through smart devices (smarthphones).*

FORMAT-EO (FORmation of Multi-disciplinary Approaches to Training in Earth Observation).

Summer school, Funded ERASMUS IP project (years 2013-14 12 days); Head: University of Leicester, UK, PARTners: POLIMI and others; Expertise of teaching Staff Polimi Partner, R. Brumana PI: Geomatics and the use of satellite data, UAV images and ancient maps to interpret built environment development

PORL EU FESR (2007-13) 'Multimedia system for the presentation and participated recognizing of the environmental values of the landscape of the Lake of Como'. Virtual Museum. Polimi: Prof. Della Torre. R. Brumana Scientific Responsible of the Multimedia Museum of the Como Lake, Historical Hamlets (Borghi Storici) and Lake Front View High Resolution Front View Map, Interactive physical and virtual visit - the Municipality of Tremezzina (Polimi Scientific Support).

EU FESR CPRE (INTERREG, 2013-14) La Conservazione Programmata nello spazio comune Retico. Planned Preservation in the Retic Alps' – S. Della Torre Sc. Resp. POLIMI, R. Brumana Scientific Responsible of the *Surveying/modeling/SCANtoHBIM of the Masegra Castle* il post processamento di scansioni laser per la generazione di modelli HBIM as-found/ as-built a differenti livelli di dettaglio (LOD), informazione (LOI) e accuratezza (LOA). La generazione dei modelli ha previsto l'integrazione di diverse tecniche di modellazione avanzata sia in ambiente NURBS (Non Uniform Rational Basis-Splines) sia in ambiente parametrico per la generazione di oggetti tridimensionali complessi a supporto di differenti tipologie di analisi, FEA- finite element analysis, MIDAS ©, VR-AR Virtual and Augmented

reality, Cloud Computing).

IT projects

GAMHer Geomatics Data Acquisition and Management for Landscape and Built Heritage in a European Perspective (Programma PRIN - Progetti di Ricerca di Rilevante Interesse Nazionale – Bando 2015, Prot. 2015HJLS7E, POLIMI Research Unit, R. Brumana Sc. Resp). Attività di ricerca, sviluppo di un sistema di analisi e monitoraggio dei danni causati da eventi di inondazioni estreme da climate change con applicazione ai beni e paesaggi culturali. Caso studio esaminato: il sito archeologico di S. Clemente (con Terme Romane e Sedimi Tardo Antichi), situato nel letto di fiume Centa, soggetto a inondazioni cicliche con perdita del patrimonio del sito Archeologico, Albenga, Liguria. (<https://site.unibo.it/gamher/it/il-progetto-gamher>). In Collaborazione con la Soprintendenza Archeologica – Liguria-Albenga.

2010-2012, **PRIN 2008**, 20088WBZFP, **National Scientific Coordinator**: R. Brumana. ICT and Cultural Heritage. Information Technologies and Cognitive system for 3D representation.

2009-2012, OPEN ATL@S GEOPORTAL (Water&territory)", 2009-2012; www.atlantestoricolombardia.it (Atl@nte dei catasti storici e delle carte topografiche della Lombardia. Navigare oggi il tempo del territorio di domani). Project Head: Prof. R. Brumana (Funding Source, Fondazione Cariplo, rif 009.n.2006). (Total Budget 695.K€). 2009-2012, 36 months.

2002-2006, **SIDART project 'Sistema Integrato per la Diagnostica dei Beni Artistici'**, PON Technologic Research Development and High Education program (PON Programma Operativo Nazionale "Ricerca Sviluppo Tecnologico e Alta Formazione" 2002-2006), Head of Consortium CETMA, Research City of Brindisi, involving ENEA-Frascati, Partner Politecnico di Milano, ISUFI (Università degli Studi di Lecce), Politecnico di Bari, INOA (Istituto Nazionale dell'Ottica Applicata), EL.EN. S.p.a., ATS S.r.l.). Scientific Coordinator of Politecnico di Milano, Prof. S. Della Torre, BEST, Prof. R. Brumana DIAR, Responsible for sw developing (MiMoLSP, Multi scale Modeling for Object reconstruction from Laser Scanner and Photogrammetry) to support LS Prototype developed by ENEA to generate 3DOrtophotoModel from Laser Scanner Point Clouds with modules of virtual animation and navigation (applies: Tarquinia' Etruscan Tomb of Demone Azzurro, Imperial Forum in Roma Basilica of S. Maria Antiqua with Paleo-Christian frescos) .

PRIN 2004-06, National Research Programme, Evolved structure of digital-mapping for the GIS and the web. Responsible of Polimi UB Prof. R. Brumana, WEBGIS: GeoDBase sharing and system interoperability to support service distribution at the urban scale. Funding Source: Italian Ministry of University and Research-PRIN.

Consultancy contracts

Responsibilities in Research and Consultancy Contracts, Consultancy Contracts and products

She has been responsible of research contracts on survey data acquisition, processing and management on Environmental and Cultural Heritage domain, among which:

Public Administration MIBACT, Parco Archeologico dell'Appia Antica (PAAA).

2022 - "Parco Archeologico dell'Appia Antica, "Villa dei Quintili – Area archeologica centrale". Rilievi laser scanner e fotogrammetrici, modellazione 3D e XR". Digitization of the Villa dei Quintili together with the Thermal Roman Areas, VR/AR/MR, Digitization of Sculptures of the Museo Archeologico Romano e Museo dei Quintili provenienti dalla Via Appia Antica.

Public Administration MIBACT, Parco Archeologico dell'Appia Antica (PAAA)

2021-2022, Parco Archeologico dell'Appia Antica, tratto demaniale della Via Appia Antica, tratto Capo di Bove civico 195 - Frattocchie (circa 11.4 km), Digitalizzazione Scan-to-XR. Rilevamento laser scanner, restituzione geometrica 3D interoperabile webgis /XR) finalizzata alla realizzazione di un Digital Twin di supporto alla conoscenza e alla progettazione

Public Administration MIBACT, Parco Archeologico dell'Appia Antica (PAAA)

2021, Parco Archeologico dell'Appia Antica, segmento del Parco della Torre del Fiscale - acquisizione, rilevamento, digitalizzazione e HBIM di supporto alle opere di restauro finalizzato alla realizzazione di un Digital Twin sperimentale.

ENTERPRISE: OIDC UK Limited (London, UK) - OPPO

Ca' Granda 'Il cortile dei bagni' - "Ex Ospedale Maggiore" di Milano (Milano, IT) Digitalizzazione (fotogrammetria e scansione laser), acquisizione dati, modellazione e mappatura delle texture per piattaforme VR e XR (Milan Design Week 2021, Oppo)

Public Administration MIBACT, Parco Archeologico dell'Appia Antica (PAAA)

2021, Parco Archeologico dell'Appia Antica, attività svolte a supportare la progettazione delle opere di percorso di accessibilità multimediale tra il III ed il V miglio dell'Appia Antica. Digitalizzazione e modellazione texturizzata a supporto della progettazione, divulgazione e comunicazione VR/AR/XR/Ologrammi/Videomapping (Ambienti del Mausoleo di Cecilia Metella e di Santa Maria Nova).

CONSULTANCY CONTRACT – copernicus4regions (Cop4Reg); Sc. Resp. : Publication Management for joint NEREUS/ESA second publication (n.150 best practice reviews - double peer review process management and Conference Software - ConfTool Pro 2.6.106+TC © 2001 - 2017 by H. Weinreich, Hamburg, Germany <https://www.conftool.pro/>; <http://www.nereus-regions.eu/2018/05/23/copernicus4regions-launch-event/>

Other consultancy contracts

Municipality Arquata del Tronto Ascoli Piceno, 2019-2020, Arquata del Tronto (IT) **Earth quacked hamlet of San Francesco** and cloister surveying (TLS, MMS SLAM and multi-image acquisition) for crack detection structural monitoring HBIM (3Dvolume stratigraphy) XR-VR/AR/MR.

Municipality Arquata del Tronto Ascoli Piceno, 2019-2020, Arquata del Tronto (IT) Earth quacked Rocca di Arquata (TLS, MMS SLAM and multi-image acquisition) for crack detection structural monitoring HBIM (3Dvolume stratigraphy) XR-VR/AR/MR.

2015-2018, **Middle Age Azzone Visconti Bridge** – 3D Photogrammetry, LIDAR data and ZEB SLAM data integration with materials decay and construction techniques within HBIM modelling, BIMtoFEA and BIM monitoring; Virtual Reality (VR), Augmented Reality (AR); Comune di Lecco, Assessorato ai LLPP

2014-2018 Palazzo Magio (Cremona) HBIM-GEODB HUB Vault repository;

2012-2014, HBIM LOD LOG LOA protocols definition, Basilica di Sant'Ambrogio HBIM based Virtual Museum tuned to XR, . Surveying to HBIM of the **Basilica di Collemaggio funded by ENI National Energy Agency after the Earthquake in L'Aquila**;

2013-2017 - Virtual MultiMedia Museum of the Landscape of Como Lake

2007-8 **Guglia Maggiore of Milan Cathedral** (UAV surveying and modelling). Cathedral of Milan Spire surveying with UAV flight and fast continuous image block acquisition-orientation-adjustment to support the dome monitoring and crack analysis detection.

2004-2008 **E-VMV Surveying, Modeling and Virtual Museum of the Royal Villa in Monza Park (Expo)**

2001-2008, **Basilica of San Marco, Venice** (Consultancy contracts for the realization of the 3D-Orthophoto, mosaic floor and domes; Precision Levelling for GIS water rising management and monitoring of the Place of San Marco and the Basilica).

2009-2012, **"Progetto GUGLIA. Progetto di Rilievo della Guglia Maggiore del Duomo di Milano"**, scientific Responsible with Prof. C. Monti and collaboration to the survey till the 1st year of the Research Contracts (2009) for the UAV/RC (Radio Controlled/Unmanned Aerial Vehicle) experimental survey with the photogrammetric platform developed for Cultural heritage purposes. Research Contract BEST Dept., Funding Source: Veneranda Fabbrica del Duomo. (Total Budget BEST 522. K€).

2003-2008, **Villa Reale di Monza**. Funding Source: Agenzia del Territorio. Project Heads: Prof. C. Monti and Prof. R. Brumana. 2003-2005, Topographic and photogrammetric survey of the Villa Reale di Monza to support of the international design competition for restoration - I ,II,III Lotto. (Budget 488.5 k€). 2006-2007, IV Lotto E- VMV Virtual Museum Villa for remote access of 3Dphotogrammetric survey to support planned conservation and divulgation programme, Project Heads: Prof. C. Monti and Prof. R. Brumana (Budget 270. k€). 2008, V Lotto, 3DOrthophoto integrated by Laser Scanner Surveys of the Halls sited at the I and II Noble Floor of the Central and North Building. Project Heads: Prof. C. Monti, Prof. R. Brumana (Budget 276. K€).

2003-06, **Basilica of San Marco, Venice**. High precision general levelling, Laser Scanner Survey and 3D-Orthophoto of the mosaic floor, Venice. Project Heads: Prof. C. Monti, Prof. R. Brumana. Funding Source: Procuratoria di San Marco (Budget 211.0 k€).

2006-2007, **'Andrea Mantegna Project.. Madonna in Gloria tra i Santi...'** (Canvas Painting Milan, Trivulzio Collection)', Multimedia communication on the interdisciplinary results of an innovative

monitoring scientific approach', Copyright reserved Politecnico Monti/Brumana©2006, displayed at the Museum of Castelvecchio, Verona and in the Pinacoteca del Castello, Milan, in occasion of the celebrations of the 500th year of the death. Credits: Project Head Coordinator: L. Toniolo, Politecnico (DEI, DIIAR, Fisica), Centro conservazione e valorizzazione dei Beni Culturali, Opificio delle Pietre Dure-Firenze, Istituto Nazionale di Fisica Nucleare, Istituto di Fisica Applicata- Università di Milano, INOA (Istituto Nazionale di Ottica Applicata), CNR&Gruppo Beni Culturali, R. Brumana the 'Global Shape Recognizing of the Mantegna's Madonna in Gloria'(DIIAR), on which results the 'Opificio delle Pietre Dure di Firenze' carried out the canvas intervention. A 1:1 scale representation has been exposed at the Civici Musei del Castello Sforzesco di Milano to explain the experimented methodology.

2003--04, **Laser Scanner and Photogrammetric Survey of the Basilica of San Lorenzo in Milan** (50. K€).

2003-05, **GISWEB Historical Centers of Municipality of Cantù**, Project Heads: Prof. C. Monti, Prof. R. Brumana, Funding Source: Cantù Municipality (Budget 67.2 k€). 2005-07, Sistema informativo territoriale per il Comune di Gorgonzola, Project Heads: Prof. C.Monti, Prof. R. Brumana, Funding Source: Gorgonzola Municipality (Budget 102.0 k€).

2000-2001. **Agreement (POLIMI-Osservatorio CIVIS per il Centro Storico, Genoa)**, for Research development to identify technical, methodological and organizational solutions to guarantee interoperability between GIS in an urban frame work (WEB-GIS prototype for data sharing of the historic Centre of Genoa). Convenzione per lo "Svolgimento di una ricerca volta ad individuare soluzioni tecniche, metodologiche ed organizzative a garanzia dell'interoperabilità dei sistemi informativi territoriali (SIT) in ambito urbano": realizzazione di un WEB-GIS per la distribuzione delle informazioni del Centro Storico di Genova.

Publications

Autore di oltre 250 Pubblicazioni

H-Index: 21, i10-index: 27, Citazioni: 1532; 98 doc

- Scopus: <https://www.scopus.com/authid/detail.uri?authorId=6507761201>
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- Research Publications at Politecnico di Milano

Editor –Co-Editor

Brumana, Tucci, Lerma (Eds), 2019, **Special Issue: Informative Models and Systems for Virtual Museums**. In: Virtual Archaeology Review, 10(21): 2019, pp.1-131, <https://polipapers.upv.es/index.php/var/issue/view/908/showToc>.

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Publication Manager

Publication Manager: *The Ever Growing Use of Copernicus across Europe's Regions* publication (2018) showcases 99 user stories that describe how public administrations across Europe are using Copernicus data and information to address their challenges and how this is positively impacting the lives of citizens.

This initiative is managed by the Network of European Regions Using Space Technologies (NEREUS), under a contract from the European Space Agency and funding from the European Union, in collaboration with NEREUS.

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Brumana, R., Stanga, C. & Banfi, F. (2021). "Models and scales for quality control: toward the definition of specifications (GOA-LOG) for the generation and re-use of HBIM object libraries in a Common Data Environment". *Applied Geomatics*

Stanga, C., Brumana, R., Previtali, M., Landi, A. G., and Banfi, F. (2021). Extending 3D quality modelling for earthquake-damaged stone masonry wall: combined digital models for building archaeology, *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLVI-M-1-2021,721–728

Gabriele, M., Brumana, R., Previtali, M. and Cazzani, A., Monitoring landscape degradation in Mediterranean areas integrating MEDALUS and Remote Sensing for fragile Archeolandscape planning: the Basilicata case study. 2021, May. Proceedings of the ARQUEOLÓGICA 2.0 - 9th International Congress & 3rd GEORES - GEomatics and pREServation, pp. 325-334. Editorial Universitat Politècnica de València <https://doi.org/10.4995/Arqueologica9.2021.12147>

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Virtual Hub and Application Implementation

POLIMI - ABCIab GICARUS (R. Brumana Sc. Responsible)

Equipment and Infrastructure:

Technical equipment (owned by POLIMI - ABCIab Gicarus, R.Brumana Sc Resp):

Mobile Mapping System MMS GEOSLAM ZEB, LIDAR Terrestrial Laser Scanners (N.2 Faro Focus3D, RIEGL, LEICA), Monitoring Total Station Leica TCA2003, GPS N.2 TRIMBLE RTK Master+Rover.

UAV Falcon8 with IRT/RGB sensors (2Kg Payload), microdrones (Phantom, 4 Dji) for fast3D sceneries in archeological and landscape contexts, Digital Cameras (Nikon, Canon full equivalent sensors, Fixed Calibrated lengths for Photogrammetry/SFM, other lens), IRT FLIR Camera.

Modelers, BIM SW licences (Autodesk REVIT®, Archicad®, McNeel Rhinoceros®, BENTLEY, Esri ARCGIS®, Intergraph®), Open Source softwares: OPENBIM, RDF, QGIS opensource. Workstations and Laptops for HBIM-GIS, data modeling, processing and management,

Photogrammetric processing / 3D Image reconstruction SW /Orthophoto/ Orthomosaic/DEM/OBJ with textured models/3D Image Photoscan/ Metashape AGISOFT®, BENTLEY Context Capture®.

Remote Sensing and Copernicus satellite data processing /GIS: 5 multi-licences ERDAS® Esri ARCGIS®, Intergraph® QGIS opensource.

XR-platform supporting AR-VR-MR implementation; Unreal Engine. Devices Oculus, Hololens; Smartphone and I-devices for AR Android. .

Hosting Server POLIMI-ASICT. Hosting GEO Virtual Hub Server and GEOPAN APP (POLIMI-ASICT): an Open Source semantic based Infrastructure developed to manage Open Data, linked data, Geographical Open Data using the Italian Virtual Hub for the GeopanAtlas APP implementation (Architectural Components: Open Layer, WTS, and others). 3Terabyte capability. Hosting Server Polimi ASICT, www.atlas.polimi.it (DABClab-GIcarus, R.Brumana Sc Resp.).

GeopanAtlas APP platform implementation (Architectural Components: Open Layer, WTS, and others). 3Terabyte capability : Geoportal open source Infrastructure, source test web site Infrastructure for multi-temporal Geodata access and sharing map series and HBIM repository; Typo4.4.5, Geoserver, WMTS, A360. GEOPAN-APP managing GEODB HUB discovery and access to open data. www.atlas.polimi.it (DABClab-GIcarus, R.Brumana Sc Resp.).

Infrastructure for the On site Museum and Outside access: The Virtual Musesum of the Landscape of Como Lake: SDI, with different devices, Smartphones, tablets. Hosting Server Polimi ASICT, www.atlas.polimi.it (GIcarus LAB, R.Brumana Sc Resp.).

ATL@S GEOPORTAL Geoportal open source Infrastructure. Geoportal open source test web site Infrastructure for multi-temporal Geodata access and sharing map series and HBIM repository; Typo4.4.5, Geoserver, WMTS, A360. GEOPAN-APP managing the HBIM-GEODB HUB discovery and access to open data. www.atlas.polimi.it (GIcarus LAB, R.Brumana Sc Resp.)