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D-SITE

Drones - Systems of Information on Cultural Heritage for a spatial and social investigation

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PREFACE

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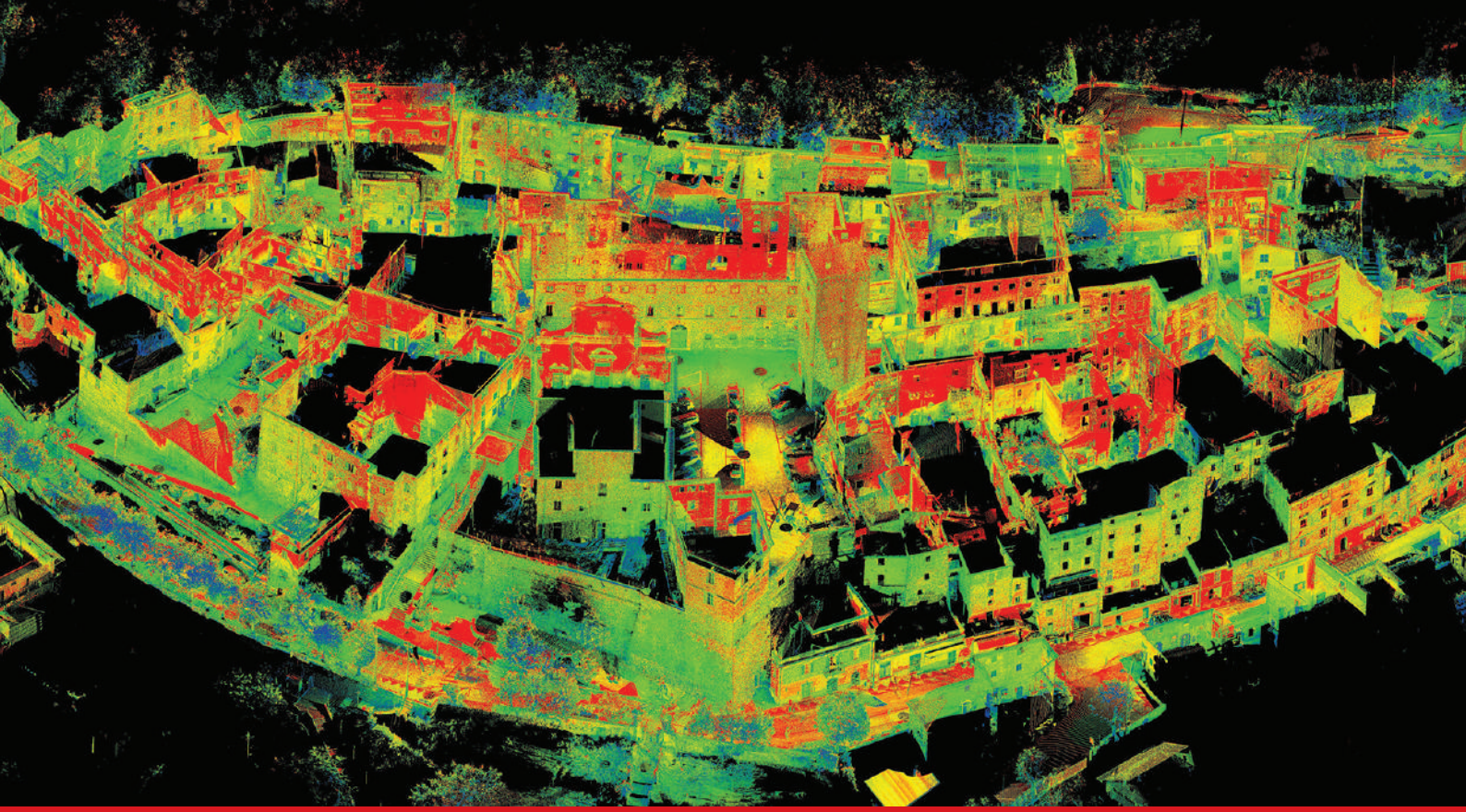

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Fast survey, Deferred survey, Restoration, Protected site.

ABSTRACT

In the field of Cultural Heritage fast survey becomes essential, because it responds to needs to restore historical, architectural and environmental heritage to avoid damage and degradation. In recent years there have been several applied research in this field. This paper reflects on two different case studies (which were acquired with deferred and fast survey techniques using UAVs), investigating integrated survey and information level of reliability for redevelopment and restoration purpose.

Fast assessment survey for protected architectural and environmental site

1. Introduction

In last 10 years, in field of representation, communication and valorization of Cultural Heritage, there has been a succession of experiments with innovative digital processes and a very large production of high-potential and low-cost technologies. This has led to a radical upheaval in a sectorization of some disciplines, proposing ever wider objectives in scientific, productive and social fields, extending, in fact, the possibilities of managing and using knowledge. In field of survey, most of the processes and methodologies now considered consolidated (TLS - SfM) are now further strengthened thanks to the development of automatic control technologies that expand the possibilities of investigation in different scales, from territorial to architectural detail. Ever-growing offer of remote-controlled UAV technologies, equipped with high-resolution cameras, has raised horizons - literally - in the field of scientific research, offering accurate results - from a metric and material point of view - that can be reached quickly.

Speed in field of Cultural Heritage is a fundamental aspect, which responds to a need to urgently recover historical, architectural and environmental heritage, avoiding deterioration, instability and loss. It can be said that a survey is fast when relationship between data acquisition times and quantity of useful data acquired is positive. The research focuses on a part of building heritage spread throughout Italy, historic town: urban agglomerations - historic center, walls, scattered buildings - which integrate perfectly with the surrounding areas. These places are open and/or complex spaces, made up of historical-artistic artifact and elements of environmental-landscape value. For this reason, survey, at the same time, must satisfy accuracy from architectural scale (blocks and individual buildings) to urban one, and detailed one. It is therefore necessary to have integrated digital sensing techniques that combine data accuracy and relatively short fieldwork times. To test critical issues and skills of these techniques and for the purpose of recovering the widespread built heritage, a case study is tested, declined on three different scales: the medieval town of Pofi and its Parco della Rimembranza (little city park), the first seen as an architectural value and the other as a territorial value, which is entered through a gate, the detail value.

2. Cases study

First evidence of existence of Pofi can be found in a document from the Montecassino archive, dated 1019 (De Santis et al, 1997) where the town is described as "Castellum" (Cioci, 2013). The term Castellum, in addition to real fortress, also indicates a fortified town, including a church (S. Maria) (Campoli F. M., 1982).

Expansion of the city in medieval times was characterized by construction of tower houses that followed an ovoid shape around the first fortified part of the town (Campoli E., 2010). Materials used in town construction were local basalt (gray or black), extracted from the volcanic rocks on which was built Pofi. Medieval part of Pofi represents the first case study.

Main part of the Castle consists of a massive 25 m high basalt stone watchtower and walls with two gates and fortified ramparts. The two gates were called "Ulivo" and

"Melangolo". Ulivo gate was demolished in 1872 due to a new urban layout that connected the new market square with the medieval village. Melangolo gate still exists today and is made of a double perpendicular passage with a triple defensive closeout. It was made of local chiselled basalt stone with a wall texture consisting of regular parallelepiped ashlars joined by mortar (Cristofanilli, 2004). Melangolo gate represents a detail of city walls, and it is the second case study.

Environmental area located outside the town walls and called "Parco della Rimembranza", was made by Giovanni Battista de Carolis between the end of the seventeenth and the beginning of the eighteenth century (Campoli, 1982). He built the so-called "Villino al Giardino", whose entrance was located in Via Carbonaria (now called Via Marconi). The gate consists of two chiseled tuff monoliths. On the south-west side there are terraces bordered by walls that mark the slope up to the Villino, made with local sandstone and lava stone. A staircase leads from the park entrance to the Villino and is bordered by walls with sandstone/tuff blocks and lava stone. The area of environmental value is the third case study. (Figures 1,2,3)

3. Differed survey

Firstly, we take advantage of a type of data acquisition belonging to fast survey category. It can be called "deferred survey", which means the existence of a time distance between the period of data collection and their processing (Empler, 2017).

Data consists of digital archive documentation made available by institutional and non-institutional corporation, by open access platforms or, more generally, by web data. This survey should not be confused with simple documentary or cartographic research: the research consists on using directly drawings or representations, on the contrary, in deferred survey, unprocessed collected data are used (aerial photos, panospheric images from google, geotiff, etc.) as well as editable data and vector shapefiles. A problem of data coming from this surveys is the difficulty on checking their quality, accuracy and

Figure 1. Nadiral view of Pofi's ancient town.

Figure 2. View of the environmental area next to the town.

Figure 3. Merangolo gate, object to be studied in detail.

reliability, also because they could grant condition of things of places that may no longer be the current one.
First survey session therefore consists in acquisition of "derived" data (Calvano, Guadagnoli, 2016) from two website: official website of Lazio Region and Open Street Map.
Lazio Region website provides shape files that contain both spatial information in vector format and attributes that can be associated with spatial information themselves. They are a series of numerical and textual metadata concerning, for example, height of buildings, number of floors, etc.
Type of data and data accuracy allow to provide only general state of places in urban and territorial scale. Indeed, it is possible to model a morphology of the ground and generic volumes of buildings, and their distribution on the ground.
However, geodata acquired thanks to this process (latitude, longitude) made it possible to georeference subsequent data deriving from massive data acquisition. The procedure, to become multidimensional, requires changing from a concise model to a detailed one through massive acquisitions data. (Figure 4)

4. Massive acquisition

Pofi's hancient town has a complex morphology, made up by very narrow streets and views of the landscape panorama. This spatial conformation meant that it was not possible to use a single survey technique: acquisitions via TLS were conducted with the aim of acquiring ground attacks of buildings along streets, but limitations were found regarding the upper part of the buildings and the roofs (Carnevali et al. 2018).
We therefore proceeded to use UAV technology with the aim of obtaining, in a short time, a three-dimensional digital model of roofs and ground.
It must be compatible with numerical model deriving from Laser Scanning, considering an integrative workflow between processes based on elaboration of structured point clouds (from TLS) and unstructured point clouds (from UAV).
Survey campaign in Pofi was organized into three days, by acquisitions of various density depending on the object of study (open environmental space, city walls, detailed elements). We used a TLS FARO CAM2 Focus 3D X 130 series, a phase shift laser scanner with color camera, multi-sensor GPS, compass, height sensor and dual axis compensator, used for 174 automatically merged scans per day, which were then automatically merged with SCENE.
During acquisitions step we positioned, in addition to spherical targets, also two-dimensional targets of a size that could be clearly visible even from drone (Ground Control Point - GCP).
We used a 3-axis mechanical DJI - MAVIC PLATINUM PRO drone, equipped with an integrated 12 MP camera and Gimbal. In two days, we took 1265 photographs in nadiral and inclined modes, at different heights; we defined shooting parameters according to different purposes: to guarantee the integration with data by laser scanner, to obtain a high level of automation in the subsequent phases, and to allow a GSD (Ground Sampling Distance) ranging from 2cm for territorial areas to 5mm for detailed elements (see next paragraph). We processed pictures within Agisoft Metashape: were created two chunks corresponding to every day acquisition, in order to simplify automatic point clouds creation by images with same exposure and lighting.
Following Sparse Clouds creation, we placed markers on same place of two-dimensional targets and on other recognizable points, associating spatial coordinates from laser scanner point cloud. This made it possible to obtain two dense clouds, suitably scaled and georeferenced, automatically registered. This essential step also allowed an automatic merging process based on common georeferenced coordinates between structured and unstructured point clouds within the Cloud Compare software, allowing the creation of an overall and unique numerical model (Rodrìguez Navarro 2012; Bolognesi et al. 2014; Federman et al. 2017).
For each case study, through appropriate selection and cleaning, we extrapolated three point clouds - one for the park, one for the town, one for the gate- each decimated

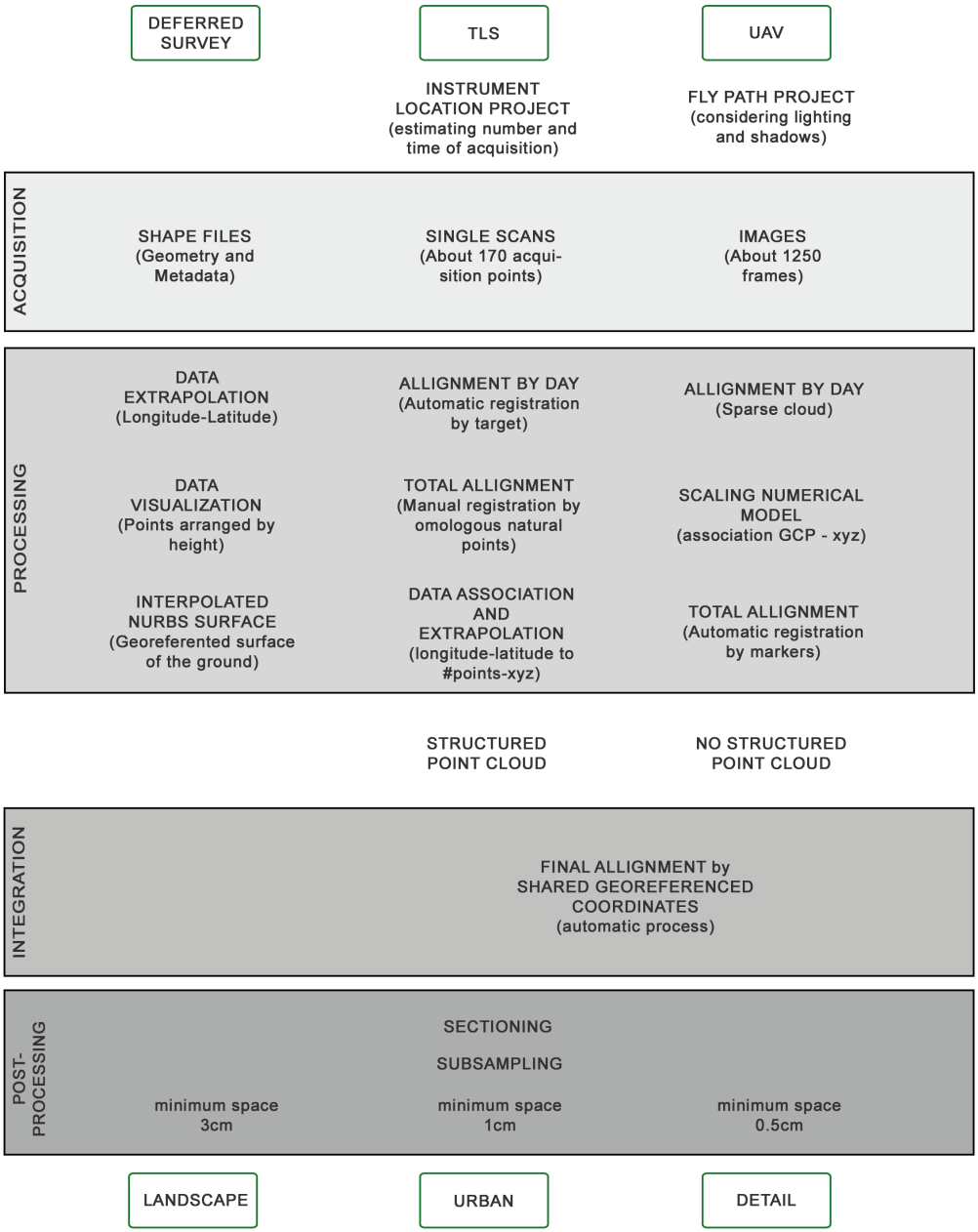

Figure 4. Workflow.

with a different criterion - 3cm, 1cm, 5mm. This is in order to obtain results with representation scale of the specific case study and in order to ensure homogeneous representations of documents that will be the basis of a conservation and enhancement planning. (Figures 5, 6, 7)

5. Data acquisition accuracy and process accuracy

In acquisition stage, evaluating data accuracy according to purposes, we considered frame scale (depending on camera lens and sensor). Therefore the first flight was set at an altitude of about 50 m AGL (Above Ground Level) which corresponds to a GSD on the ground of about 2 cm. Second flight was set at an altitude of about 25 m above ground level, which corresponds to a GSD of about 1 cm. The third flight was set with a close distance, to obtain a GSD of 5mm, which is consistent with detailed scale of representation, positioning drone not in nadiral or inclined mode but mostly in a parallel position with main position of the gate. In order to obtain a numerical 3D model (unstructured point cloud), it is necessary to consider two different levels of accuracy: relative and absolute ones. Relative accuracy refers to alignment stage of pictures and is closely linked to the error with which images are relative positioned one to the other. Absolute accuracy refers to the error found between points of the 3D numerical model and their real position in space (georeferenced coordinates), depending on the survey and depending on frame scale. Thanks to this procedure we were able to certify that numerical model's relative accuracy is about 6,5 cm for the garden area, it is about 4 cm for the historical town and the walls, and it is about 10 mm for the gate. The absolute accuracy calculated is instead about 5 cm for environmental value area, it is about 2,5 cm for urban-built area and about 5mm for the detailed object. Empirically, we can deduce that GSD values identified during acquisition stages lead to an accuracy (relative and absolute) in processing step ranging from one to three as large as GSD values. Acquisition and processing phases, thanks to the GCP coordinates detected by the scanner, made it possible to scale the object according to its real size starting from

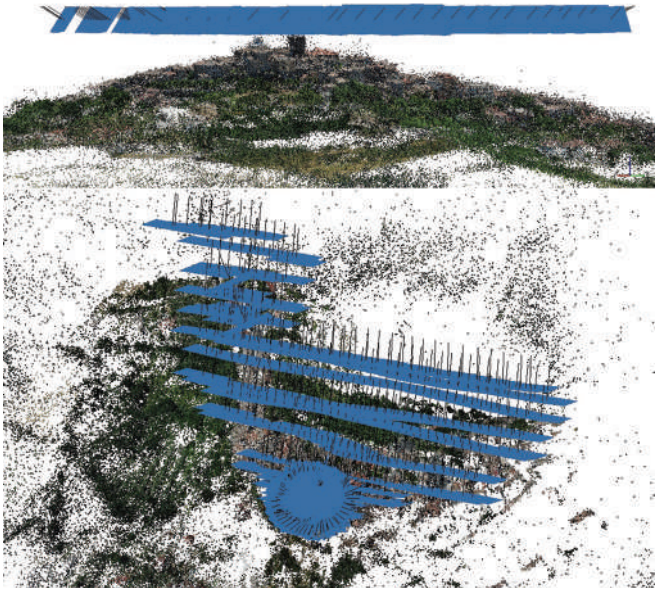

Figure 5. Views of the flight plans in the two different acquisition days (nadiral and 45 ° images).

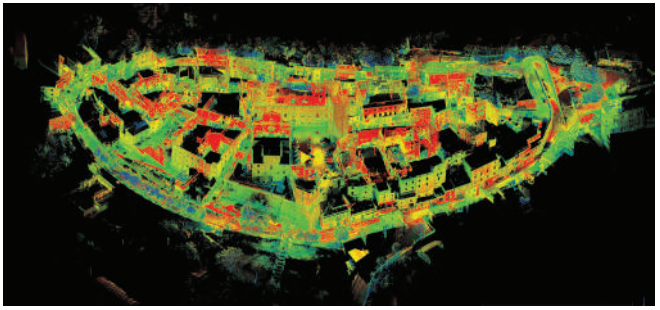

Figure 6. Structured point cloud by TLS.

Figure 7. Query of structured point cloud and coordinates acquisition.

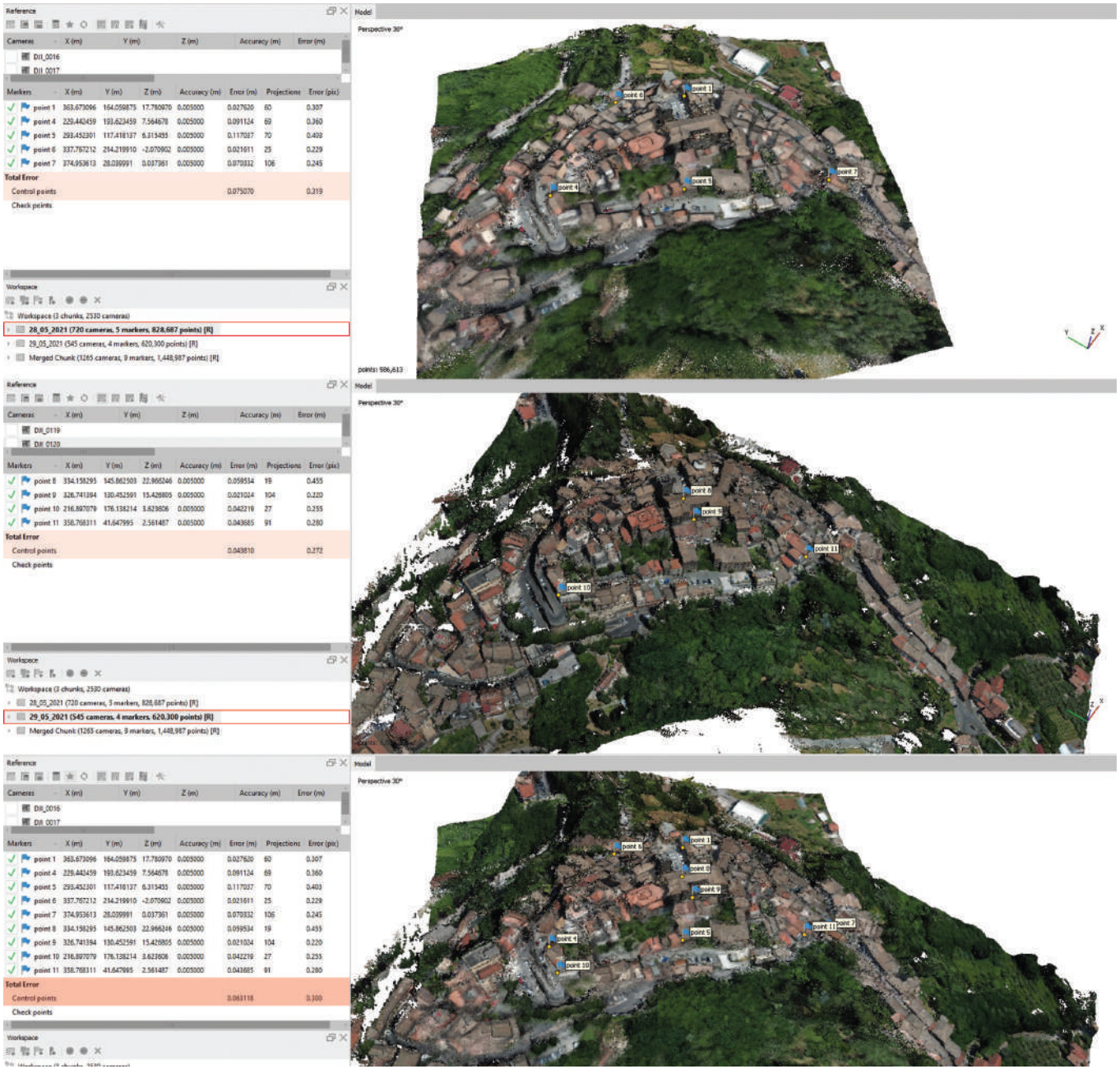

Figure 8. Creation of dense clouds scaled based on coordinates from TLS and automatic integration of the two numerical models.

the frame scale. In this way we created a coordinate system coherent with the real one and coherent with single case study. (Figures 8, 9)

6. Results and research enhancements

Research investigates data reliability collected by photomodeling from UAV, integrated with TLS data and derived data, depending on whether they are areas of environmental, architectural-urban or detail value, for dissemination and conservation purposes. Massive acquisition technique - numerical and image-based - and fast development of digital technologies facilitate and speed up traditional technical-scientific processes Cultural Heritage survey and they propose new strategies of perception and transmission of heritage for its conservation and / or valorization over time.

The development of the entire illustrated procedure (deferred survey + TLS + UAV), including data processing for an area of 54,000 square meters, required six days, (three days for survey campaign and three for data processing) and we obtained a homogeneous and geo-referenced point cloud of the entire ancient town of Pofi.

Procedure allows to understand what are, nowadays, timing of fast survey, guarantee speed and decreasing margins of error (about few cm) for urban spaces or single objects.

Numerical integrated model can be further elaborated and placed at the base of a continuous 3D model (mesh and mathematical models) characterized by dimensional features (measurability and scalability of the model), geographical features (position and morphology of the ground), geometric features (complex shapes of the fabric and buildings) and chromatic ones (RGB value).

These models can be subsequently integrated, from a BIM oriented perspective, with information deriving from specialist surveys aimed at both conservation and enhancement aspects of assets surveyed.

This Procedure was tested in the application field and proved to be effective: data collected allowed specialized people to structure a project to make alleys and medieval walls of the historic center safe and to reuse the park.

If we think of the urgency that characterizes safety measures and these projects, also to allow access to PNRR by municipal administrations, fast integrated survey proves to be an essential tool for knowledge and planning. (Figures 10, 11)

Figure 9. Point cloud automatically integrated between TLS and UAV based on shared coordinates.

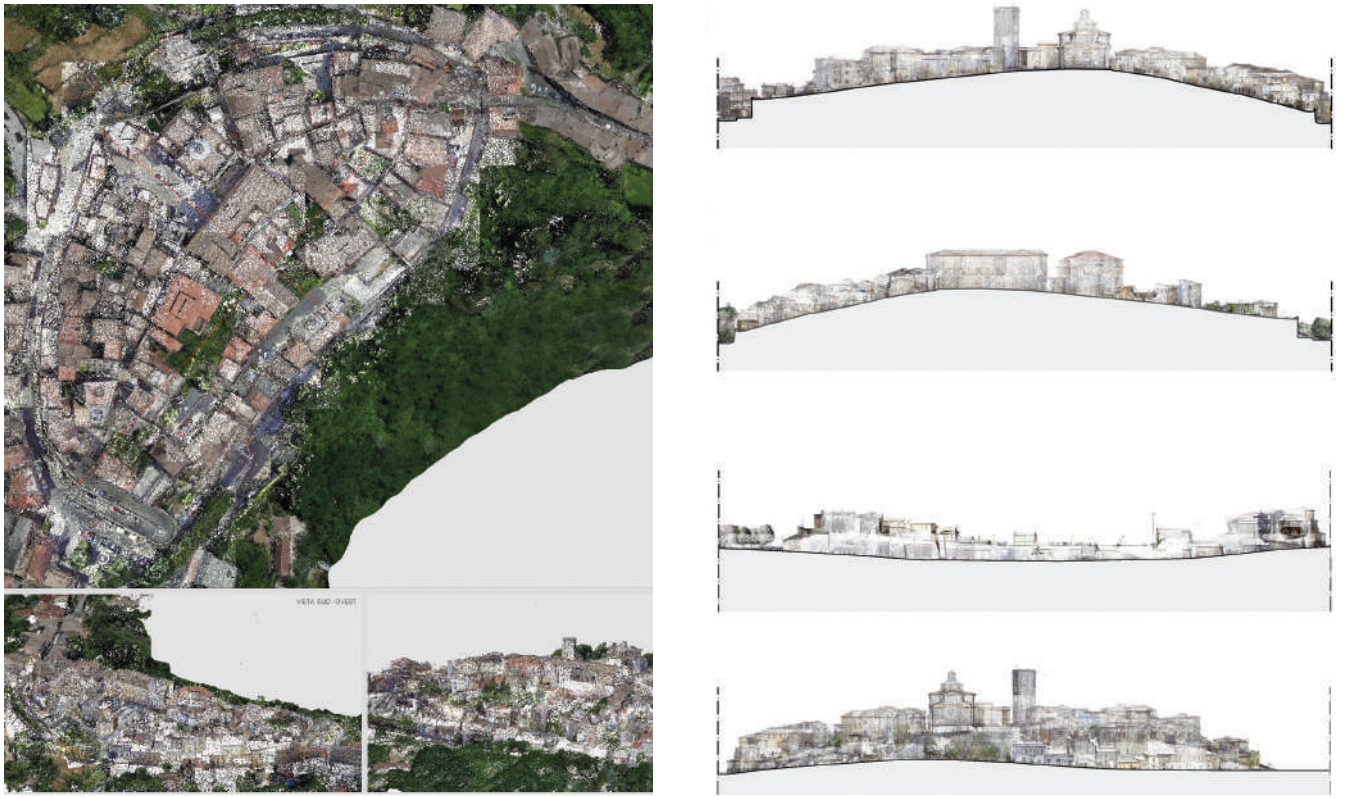

Figure 10. Territorial section analisys used as a basis for conservation and valorization planning for ancient town.

Notes

The authors shared the entire methodological process and contributed together to the results achieved. In particular, paragraphs 1 and 4 were edited by Maria Laura Rossi, paragraph 2 and 6 by Tommaso Empler, paragraph 3 and 5 by Adriana Caldarone.

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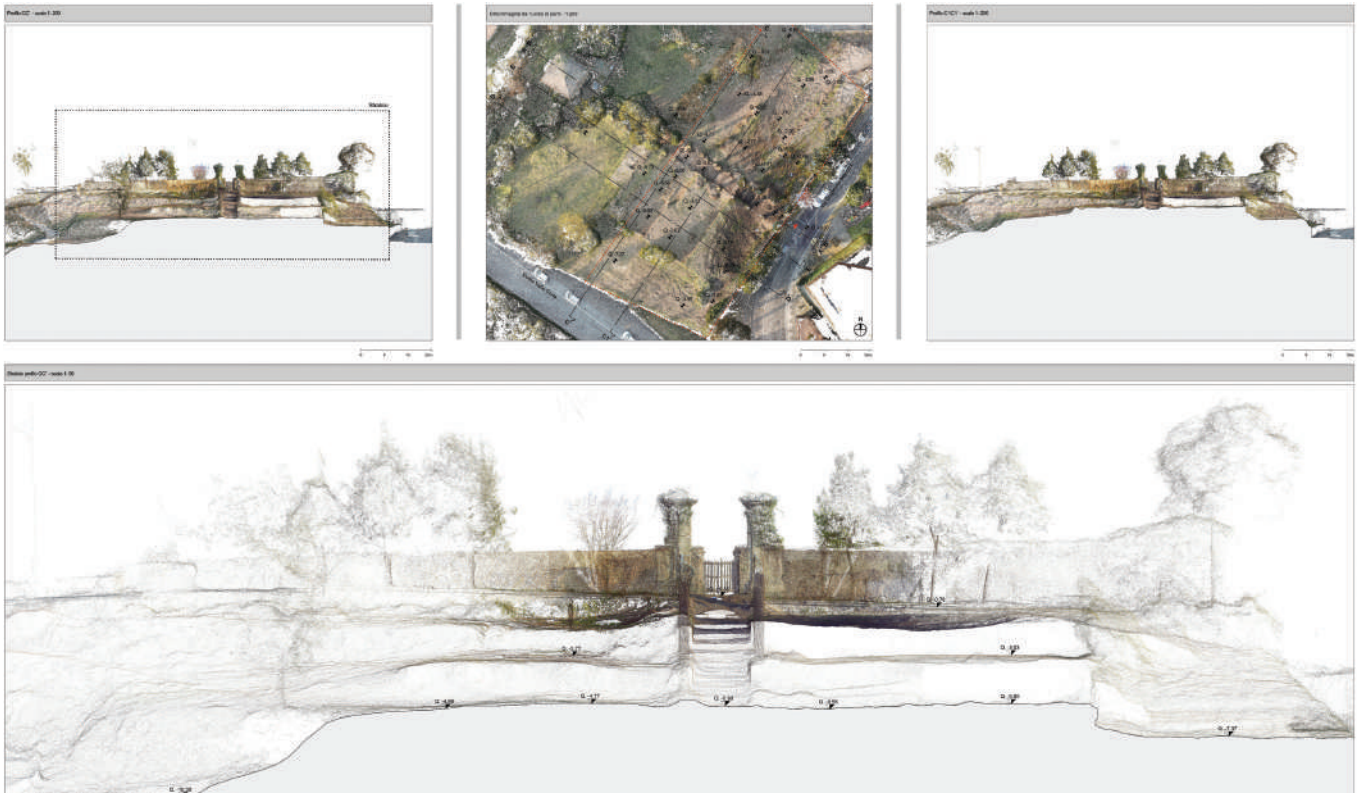

Figure 11. Studies for park settlement.

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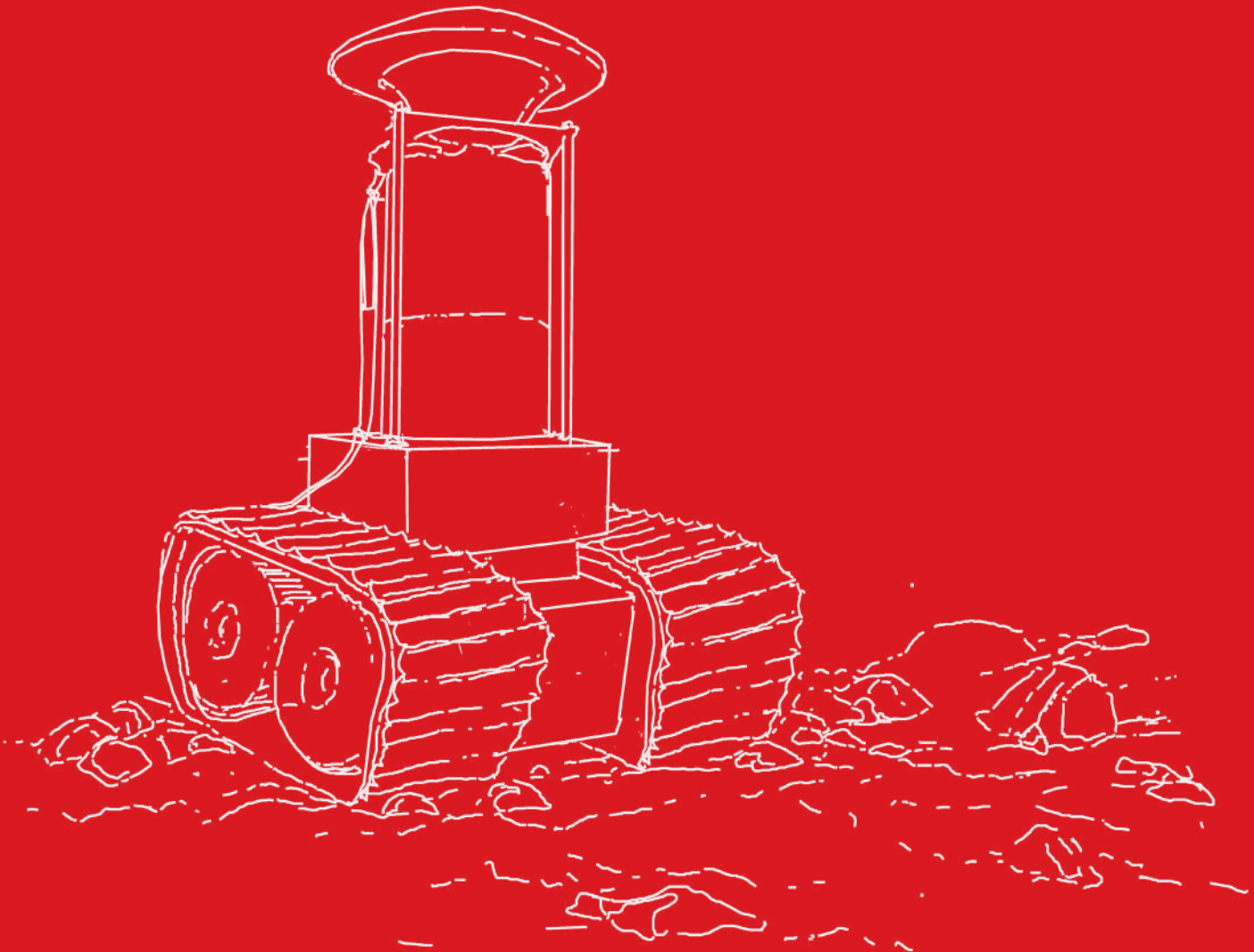

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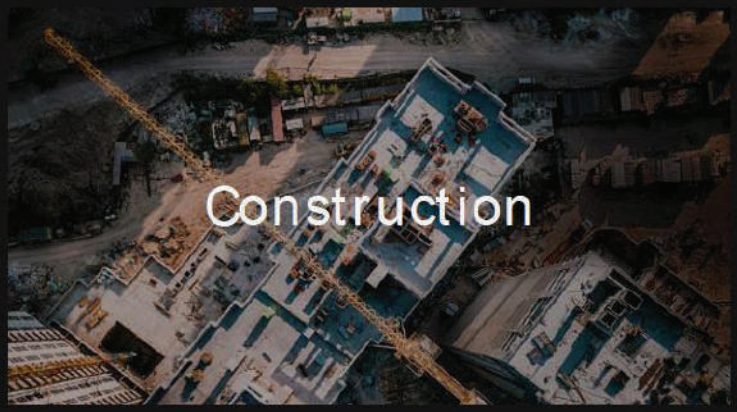

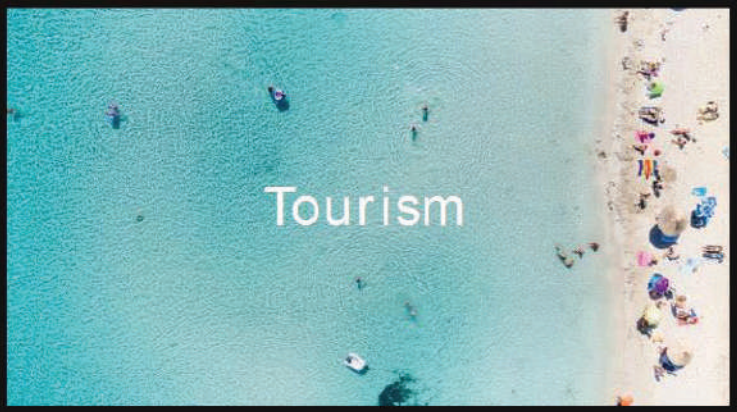


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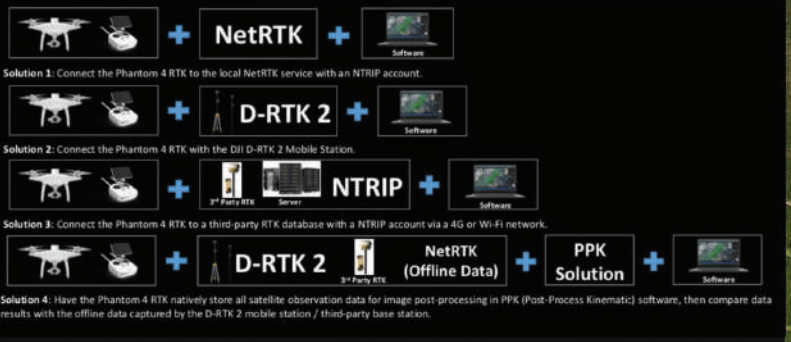

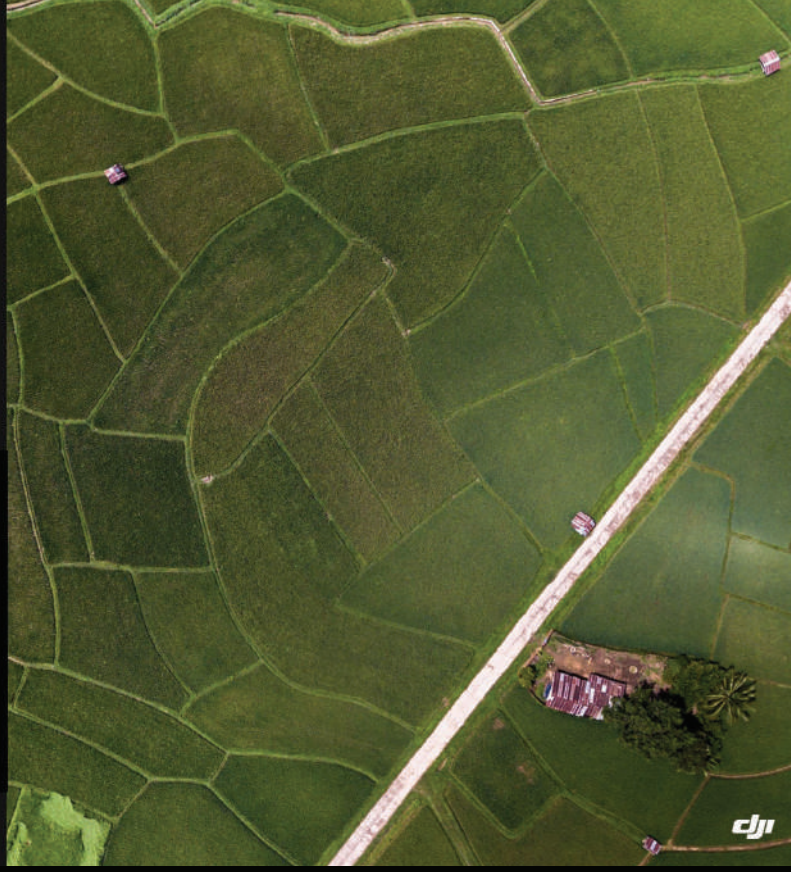

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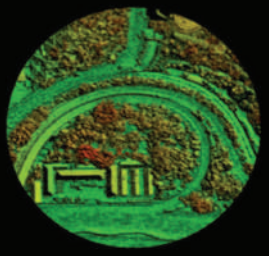

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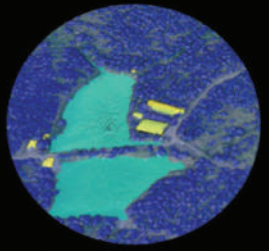

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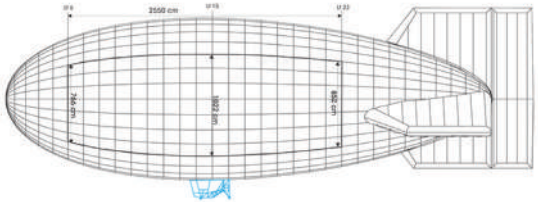
MILANO MONGOLFIERE was born from the desire to turn the dream of flying in a balloon into reality. At the base of everything there is therefore the passion for flight of our operations director, former airplane pilot, who joins the organizational skills of the accountable manager: from here our business originates, which allows us to know and make many happy people, offering a unique and unforgettable experience like that of a hot air balloon flight.
But passion alone is not enough to carry out an activity like ours on a professional level: Milano Mongolfiere, which is a Srl, is in fact an operator that complies with the European standards governing commercial flights with hot air balloons (EU REG. 395/2018).
This means that, like any other aircraft operator, we are controlled by ENAC (National Civil Aviation Authority) both for the preparation of our crews and for the maintenance of our aircraft. Flying in a balloon with us is a safe and fascinating experience, with minimal impact on the environment: in fact, we use propane gas and operate in such a way as to cause minimal damage to the area. Milano Mongolfiere Balloon Flights is one of the most important Italian companies for commercial passenger flights with balloons in Italy ; we are not a club but a real airline; we are certified by the Italian National Civil Aviation Authority (CAA)for Aerial Work, Commercial passenger Transport and Pilot School.

We place the centre of our attention :
The safety of the operations
For this reasons all the aircrafts are new, we make periodical checks on our crew and we also have a pilot school to raise new pilots.
Respect the rules
All our our employees have a contract due to national law and are insured for the specific risks of the aeronautical sector.
Protecting the environement
We are careful to cause minimal harm during our operations during preparation of the balloon and the landing.In fact we are the only ones that are allowed to fly
in the territory of the Parco del Ticino, a natural park 30 km from Milan.
Trasparency towards our clients
Milano Mongolfiere, unlike other operators, publishes the rates, certifications, terms and conditions on the website.





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ETRURIA VOLO S.R.L.

Etruria Volo S.r.l. is a company founded in 2015 and provides technological and professional services based on the use of Unmanned Aerial Vehicles. It was not born from nothing to exploit the "drone boom", but from a long and consolidated experience of the founders in the aeronautical world, ranging from teaching to design and construction, aeronautical research and development since the '80s, and in remote piloting since '91. As it is natural that, over time, collaborations with numerous and important private and public bodies have developed, including UNIFI, UNIFG, UNICH, CNR di Firenze, ANMIL, Versalis S.p.a., Eurallumina S.p.a., Raffinerie di Roma, Icaro S.r.l, Publiacqua S.p.a., ThyssenKrupp Italia, Timiopolis (BS), Polizia Municipale di Scandicci, Polizia Municipale di Prato, AREU Lombardia, etc. Our company is located in Castiglion Fiorentino, in the province of Arezzo, at the Aviosuperficie Serristori, former home of the VDS school and a particular love for flying, which in '94 realized the desire to modify its airplanes in order to be able, finally, to pilot people with motor disabilities in Italy, from which the association "Baroni rotti" was born. Etruria Volo is a company certified by ENAC for aeronautical education.For general aviation we have therefore set up an ATO (with identification IT.ATO.0084); based at the Aviosuperficie Serristori, where we use our 2 Cessna, a 180 (L-IUMM) and a 150 (I-CMAO). For remote pilot training, we have the UAV Training Centre (ENAC.CA.APR.030), also based at the Aviosuperficie Serristori and, in addition, secondary offices in Massarosa (Lucca), Montemelino (Perugia), Foggia and Tortolì (near Dorgali, Sardinia). In the Training Center we do training for both multiplane and fixed wing pilots, in basic, critical day and night operations, and we train Flight Instructors. We do both traditional training (for those who need to obtain flying qualifications), that training focused on operations, generating specific courses to be able to train in the pilot the knowledge and experience necessary to carry out specific types of operational missions, both for acquisition and inspection activities.

This type of teaching is possible through the classic courses of photogrammetry (RGB, IR and multispectral), and special courses in which we focus particularly on the specific activity that pilots will perform. Particular were the courses for AERU Lombardia, where we trained the Alpine and Speleological Rescue of Lombardy Region to operate efficiently with drones in the impervious alpine areas; or for Publiacqua S.p.a. (Florence). In addition to be instructors, we are also operators, and in order to be able to perform acquisition operations different from what is ordinary, it is spontaneous to use our decades of experience to create aircraft, sensors and procedures that adapt efficiently to the need of the activities that are required. Typical example is the use for years of IR sensors to carry out scans for structural verification, or to verify the geomorphology of the soil, or energy efficiency; or the combined use of typical and atypical sensors to verify the state of water, soil and air. Doing both Instructors and Operators and Builders, helps us to see what we do in a broad way and without losing sight of the objectives, imagining the "drones" as a convenient aerial stand that we can place where we need, it comes spontaneously to imagine and create an efficient "stand" that we can stop where we like, equipped with sensors suitable for the needs and duly modified, with the aim of acquiring multiple reliable data that can be used concretely. If one adds knowledge, love, passion and tenacity, the results are the natural consequence.

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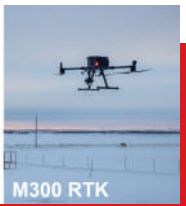
MICROGEO S.R.L.

MicroGeo has been guaranteeing solutions and expertise in the fields of surveying, measurement and non-destructive testing PnD for twenty years, with the aim of improving and organizing technical and commercial skills in some important fields of precision "contact less" measurement.
MicroGeo is partner of the main global brands operating in the field of instrumentation for UAVs systems and LiDAR sensors. As DJI Enterprise partner, MicroGeo guarantees an accurate and careful analysis of DJI drones and onboard sensors for professional use in the Photogrammetry and LiDAR sectors.
One of MicroGeo's solutions for the LiDAR UAVs survey is the combination of the new DJI 300 RTK Matrice with the DJI Lidar Zenmuse L1 sensor.
The Matrice 300 RTK is the new industrial drone of DJI House that gets its inspiration directly from modern aeronautical systems. With over 55 minutes of battery life, integration of advanced IA, six-directions sensing and positioning and many other features, the M300 RTK sets a new standard for intelligence and reliability combined with performance that has never been seen before.
The Matrice 300 RTK has a payload capacity of 2.70 kg and up to 3 instrument loads simultaneously. The new ZENUMUSE series (L1, P1, H20T,...) sensors also brings a completely different meaning to work efficiency. The unique intelligence and integrated design offer unprecedented aerial imaging capabilities for a wide range of applications in the UAV world. Because of its considerable load capacity, MicroGeo believes that the 300 RTK Matrice is perfect as a drone LiDAR survey solution. A survey solution therefore that makes the DJI Matrice 300 RTK the most competitive of the moment in the world of industrial drones. Another equally valid solution the combination of the DJI Matrice 300 RTK with the LiDAR MiniVux2 from Riegl. Riegl company has always been distinguished by the use of the highest quality instruments in the field of terrestrial laser scanners and LiDAR sensors.

The MiniVux-2 is compact and lightweight (1.55 kg) with a measurement speed of 200,000 points per second, achieving up to 100 scans per second with a field of view of 360°. The sensor can include in addition to the laser head, an IMU/GNSS System and up to two RGB cameras.
There are many fields of application among which the following are listed:
Agricultural and forestry;
Glacier and snowfield mapping;
Archaeology and Cultural Heritage;
Construction site monitoring;
Landslide monitoring.
For photogrammetric and laser scanner data processing MicroGeo offers 3DF ZEPHYR Aerial software from the Italian software house 3D Flow.
With Zephyr it is possible to reconstruct 3D models starting from photographs. The reconstruction procedure is completely automatic and does not require any particular instrument. The software has multiple surveying tools such as orthophotos, contour lines, georeferencing of the point cloud using GCP. Moreover, the possibility to integrate point clouds from Photogrammetry (terrestrial and drone) and point clouds from Laser Scanner allows Zephyr to be one of the most complete software in the field of Geomatics.
Terrasolid is the industry standard software for point clouds and images processing, developed specifically for the demanding requirements of geospatial, engineering, operations and environmental experts.
Terrasolid suite provides versatile and capable tools to create 3D vector models, feature extractions, orthophotos, terrain representations, advanced point cloud visualizations, etc., no matter the data source, no matter the sensor. The finest tools for calibration and matching of point clouds for LiDAR data are included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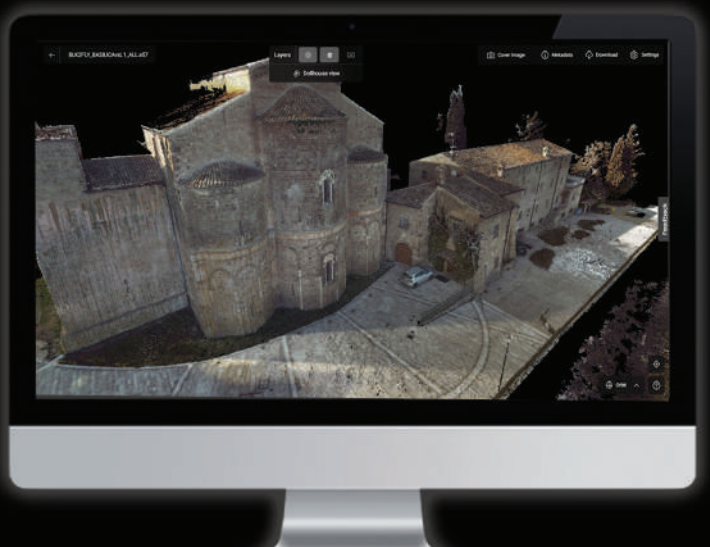
MicroGeo

D-SITE, Drones - Systems of Information on culTural hEritage for a spatial and social investigation

LEICA GEOSYSTEMS S.P.A



SCAN ME

Hexagon is a global leader in digital reality solutions, combining sensor, software and autonomous technologies. Our technologies are shaping production and people-related ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future. Each of our divisions pools collective industry knowledge and experience from teams around the world. Hexagon's Geosystems division provides a comprehensive portfolio of digital solutions that capture, measure, and visualise the physical world and enable data-driven transformation across industry ecosystems. Our reality-capture technologies create digital worlds from different views, whether a single dimension between two walls in a house, cadastral boundaries of properties or 3D shapes of cities, infrastructures, utilities, entire countries or even crime scenes. Revolutionising the world of measurement and survey for 200 years, Leica Geosystems, part of Hexagon, creates complete solutions for professionals across the planet.

The Leica BLK2GO introduced never-before-seen mobility for scanning complex indoor environments. The handheld-imaging laser scanner combines visualisation, LiDAR, and edge-computing technologies to scan in 3D while in motion, allowing users to be much more agile and efficient in capturing objects and spaces. The BLK2GO has a wide range of applications from adaptive reuse projects in the architecture and design industries to location scouting, pre-visualisation, and VFX workflows for media and entertainment.

Leica Geosystems is making reality capture fully autonomous by expanding capabilities from handheld operation to scanning with autonomous robots and from the sky. With real-time autonomous reality capture, the ability to create 3D digital twins and direct-to-cloud storage, these GrandSLAM-powered autonomous BLK laser scanners are changing the way smart digital reality is captured.

The Leica BLK ARC, an autonomous laser scanning module for autonomous mobile robots, brings its innovative 3D reality capture technology to robotic carriers and platforms. The first BLK ARC robotic integration is with the Boston Dynamics SPOT robot, with future integration plans for other robotic carriers. This innovative technology expands opportunities to capture 3D data without human intervention, continuously scanning and storing real-time data while augmenting and improving the robot's autonomous navigation system. The latest in Leica Geosystems' solutions is especially useful in dangerous or hazardous environments, with automated and repeatable scan paths to command the robot carrier while keeping employees safe. BLK ARC completes both static and mobile scans during the same mission for greater scanning agility, which boosts productivity and eliminates extra work. BLK ARC can be used in a variety of use cases, such as documenting ongoing site conditions, exploring underground mines and for public safety applications such as fire or crime scene investigations and search and rescue missions.

The Leica BLK2FLY takes reality capture innovation to a new level as the world's first autonomous flying laser scanner. BLK2FLY offers advanced obstacle avoidance while allowing users to plan entirely autonomous missions, from autonomous flight paths and scanning to intelligent return to home for battery changes to continue its mission.

Featuring simple operation and the fastest in-field setup time in the industry, Leica Geosystems' latest UAV technology can scan buildings, inaccessible areas like rooftops and facades, and other complex structures with no scan shadows and safe, stress-free user operation. Additionally, the easy-to-use BLK2FLY Live App offers real-time video view, simple touch controls for automated scanning and virtual joysticks for manual flight. BLK2FLY is the perfect drone for documenting construction progress, rapid laser scanning for BIM processes and creating digital twins for retrofits and redesigns.

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HEXAGON | Leica Geosystems

FLYTED

Flyted is an innovative start-up which collects strategic data on structures and territory.
The Company employs UAS (Unmanned Aerial Systems) and topographic-grade aerial and ground laser scanners to carry out surveys in the field of design, construction and maintenance of assets. The main application sectors are Transport Infrastructure, Telecommunications Infrastructure, Energy Infrastructure and Real Estate.
The services provided include geo-referenced survey, inspection and monitoring, with production of Point Clouds, 3D Digital Twins, CAD drawings, BIM models, photogrammetric mesh and orthophotos, high resolution RGB images and 360 ° photographs. The integration of those services allows to perform in-depth analysis, both visual and structural, about the "As-Built" or the design and construction phases of an asset.
Flyted delivers millimeter-accurate results in a tenth of the time compared to traditional methods, while eliminating workplace hazards.
The Company is part of United S.p.A., a group of companies which operate internationally in the field of "Safety & Security" and specializes in the planning, construction and management of strategic infrastructures and national interest sites. Furthermore, Flyted is supported by leading public and private equity firms such as CDP Venture Capital SGR and AVM Gestioni SGR.

OUR PRODUCTS

Digital Twin - LIDAR

Flyted, following the detection of data with LiDAR technique by laser scanner, produces 3D geo-referenced Digital Twins of the target asset with an accuracy up to 5 mm.

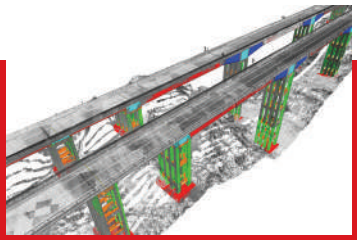
The method of acquiring data from laser scanners, terrestrial and airborne (transported by UAS), is the most precise from a geometric standpoint, being able to detect the actual state ("As-built") of the asset. The survey campaign output is a Point Cloud which represents the geometry with millimeter precision. The following phase of processing the point cloud, with a CAD or BIM modeling, is aimed to reconstruct the asset and its components.
Through our surveys, we can also create a three-dimensional reconstruction of the territory, returning a georeferenced 3D model where to calculate volumes, measurements and altimetric profiles.
Our aerial laser scanners, transported by UAS, are excellent in penetrating vegetation and generating accurate DTM (Digital Terrain Model) and DEM (Digital Elevation Model).

Digital Twin - Photogrammetry

The Digital Twin produced using aerial photogrammetric techniques is aimed to obtain hyper-realistic models and represent the original texture of the detected object. The output is a polygon mesh, able to show the smallest structure's details, which is ideal to perform visual inspections and monitor the conditions.

Photographic inspections

We perform accurate infrastructure inspections, operating the most efficient sensors to return specific data. The visible spectrum (RGB) images are collected with full-frame (61mp) or medium format (100mp) cameras with calibrated lenses and 360-degree imaging sensors. We can then integrate LWIR (radiometric IR), SWIR and hyperspectral bands, with resolution up to 1000 bands.



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