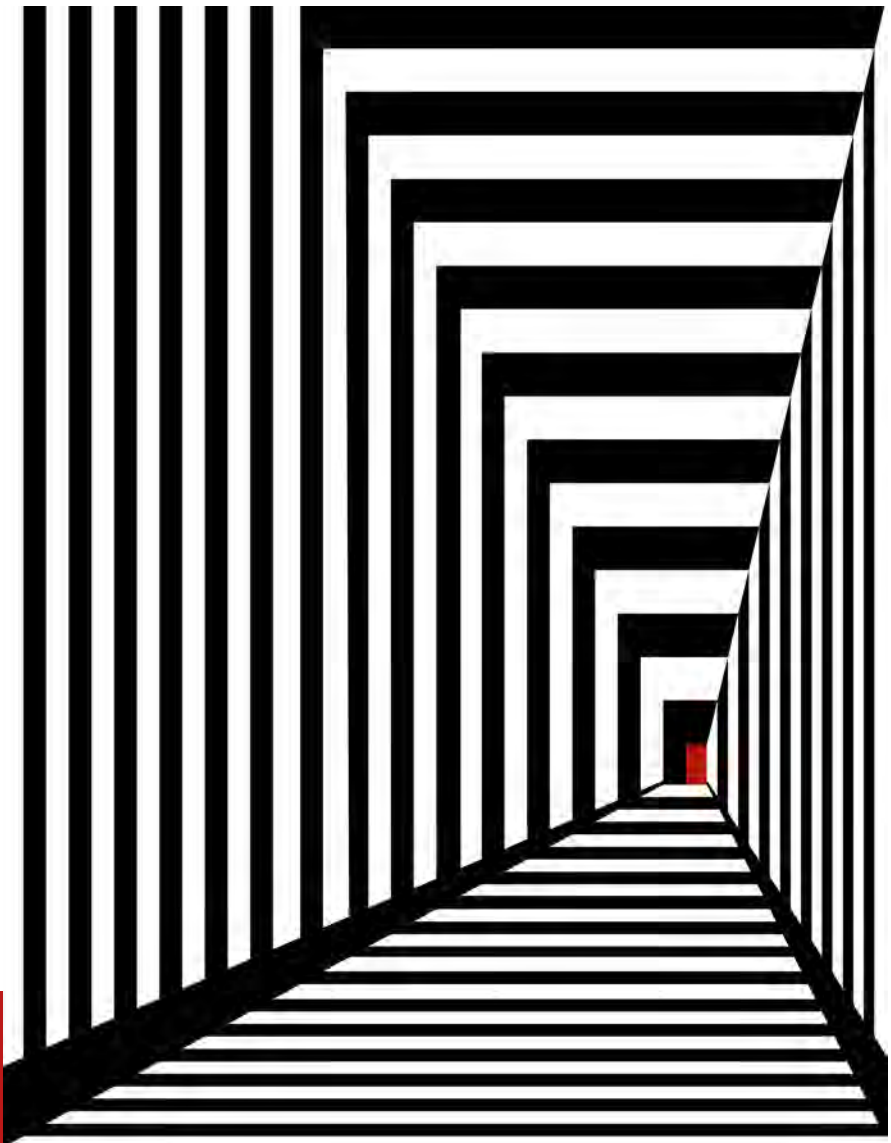
ATTI

Università di Genova

De_*Sign*
Environment Landscape City

a cura di Giulia Pellegri

2019



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International Drawing Study Day/Giornata Internazionale di Studi

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De- Sign
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a cura di

Giulia Pellegri

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CONTENTS/CONTENUTI

Una giornata, a livello internazionale, nell'ambito del progetto Di-SEGNARE, certamente importante per gli studenti, gli operatori, ma anche per la città; per questo motivo ringrazio Chris Bangle per la sua Lectio Magistralis e auspico una rinnovata collaborazione con l'Università, nello specifico con il dipartimento di Architettura e Design_DAD scuola politecnica Ingegneria Architettura di Genova, che ha organizzato questo incontro. Una giornata di studi sicuramente importante anche per il Comune, che è l'Ente preposto alla programmazione, alla gestione e allo sviluppo del territorio urbano e dei suoi servizi. Azioni, quelle poste in discussione, che si riversano su tutto l'indotto culturale, economico e turistico della città come stabilito anche dal "codice dei Beni Culturali e del Paesaggio". I Colori e il disegno rappresentano le basi per la valorizzazione e la conservazione dei nostri beni architettonici, in parte riconosciuti dall'UNESCO e sede di alcuni nostri prestigiosi Musei, ma anche della maggior parte del nostro territorio. Non possiamo infatti dimenticare alcune zone della città, in particolare quelle che hanno conosciuto lo sviluppo industriale degli anni '60-'70, pur conservando al loro interno importanti plessi storici. Fra queste anche quelle portate all'attenzione dalla tragedia del ponte Morandi, che ha messo i riflettori sulla quotidianità di questi quartieri genovesi, per cui stiamo lavorando con l'obiettivo di migliorare la vivibilità e l'estetica di queste zone, grazie anche a nuove forme artistiche come il graffitismo o anche a nuovi percorsi organizzati alle fortificazioni della città.

Ringrazio quindi tutti gli organizzatori di questa importante giornata di studi che certamente porterà a nuove idee e prospettive per il decoro di Genova.

Barbara Grosso

Assessore al Marketing Territoriale,

Politiche Culturali e Politiche per i Giovani-Comune di Genova

An international day, within the De-SIGN project, certainly important for students, operators but also for the city; for this reason I thank Chris Bangle for his Lectio Magistralis and I hope for a renewed collaboration with our University, specifically with the Department of Architecture and Design_DAD Polytechnic School of Architecture of Genoa, which organized this meeting.

A day of studies is also of importance for the Municipality, which is the body in charge of planning, managing and developing the urban territory and its services. Actions, those brought into question, which are poured on all the cultural, economic and tourist satellite activities of the city as established also by the "Code of Cultural Heritage and Landscape". The Colours and the design represent the bases for the promotion and the conservation of our architectural assets, partly recognized by UNESCO and home to some of our prestigious Museums, but also to most of our territory.

We cannot forget some areas of the city, in particular those that experienced the industrial development of the 60s and 70s while retaining important historical buildings, including those brought to the attention of the Morandi bridge tragedy. The event put the spotlight on the everyday life of these Genoese neighbourhoods, for which we are working to improve the livability and aesthetics of these areas, thanks also to new art forms such as graffiti art or even to new routes organized at the city fortifications.

I therefore thank all the organizers of this important day of study that will certainly lead to new ideas and perspectives for the decorum of Genoa.

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Interdisciplinary skills in the field of architectural surveying

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Abstract

Survey and general surveying, measurement and analysis, a system of transverse competences able to deepen the relationship between the historicaliconographic, typological, bibliographic and archival research and the metricspatial correspondences through Photogrammetric Survey and 3d modelling which provides a Reverse Modeling process.
The phases of the process of knowledge related to the survey do not end with the only graphic representation of the metric-geometric data, but a real complex design act is carried out which involves historical-iconographic, compositional, structural, technological, simple or complex decorative, perceptive chromatic and visual phases, not only at a punctual architectural level but above all at the urban level.
The technical competences that are supported during the metric-geometrical analytical phases are fundamental of the current line of this research. The photogrammetric phase of survey elaborated with the 3DF Zephyr Aerial program with which it is possible to create the 3D model. In fact, this software uses the "Structure from Motion" (SfM) technology that allows you to reconstruct the shape of objects by automatically collimating points from a set of photos.
For the roofs , photographs are made through the use of the drone DJI Spark. The model is then scaled using a 3D laser scanner with millimetric precisions and georeferenced through ground points obtained with GPS Geomax, finally from the three-dimensional are then extracted the orthodphotos of the exterior facades and the plant of the architectural system.

Abstract

Rilievo e Rilevamento, misura e analisi, un processo che mette a sistema competenze trasversali in grado di approfondire il rapporto tra la ricerca storico-iconografica, tipologica, bibliografica e archivistica e le corrispondenze metrico spaziali tramite il rilievo avanzato e la modellazione 3d che prevede un processo di Reverse Modeling. Le fasi del processo di conoscenza legate al Rilievo non si esauriscono nella sola restituzione grafica dei dati metrico-geometrici ma si attua un vero e proprio atto progettuale complesso che comporta fasi analitiche storico-iconografiche, compositive, strutturali, tecnologiche, decorative semplici o complesse, cromatiche e visivo percettive, non solo a livello puntuale architettonico ma soprattutto a livello urbano. Fondamentali le competenze tecniche che si affiancano durante le fasi analitiche metrico- geometriche dell'attuale filone di ricerca di chi scrive. Il rilievo fotogrammetrico elaborato con il programma 3DF Zephyr Aerial con il quale è possibile creare il modello 3D. Questo software utilizza infatti la tecnologia "Structure from Motion"(SfM) che permette di ricostruire la forma di oggetti attraverso la collimazione automatica di punti da un insieme di foto. Per le coperture vengono effettuate fotografie tramite l'utilizzo del drone DJI Spark. Il modello viene poi scalato utilizzando un laser scanner 3D con precisioni millimetriche e georeferito tramite punti a terra battuti con GPS Geomax, infine dal tridimensionale vengono poi estratte le ortofoto delle facciate esterne e la piante del sistema architettonico.

Survey Interdisciplinary methodological principles

Surveying architecture is an act of analysis historically recognized as an investigation of knowledge aimed at different stages of the architectural process: the measure for the ability to store data, the measure for typological knowledge, the measure for the knowledge of materials and techniques construction, the measure for the conservation of cultural heritage, the measure for the recovery of decorative façade data and the measure for the design of the new.

In the Renaissance the great tradition of surveying begins, which continued in the Baroque period and which sees the clarification of theoretical concepts and graphic standards and in the eighteenth century with the expansion of the field of investigation, was inherited and developed throughout the nineteenth and early decades of the twentieth century in academies and university faculties.

The conception of the architectural survey, however, had remained until our century, essentially in the nineteenth-century academic formulation with a rhetorical schematization and an excessive observance of intellectualistic rules, which led to consider the monument almost exclusively in the stylistic characteristics, while the structural, technological aspects and constructive were not taken into consideration. Even the environmental context, the spatial characteristics of the urban sectors were placed in the background compared to the beautiful drawing of the Academies[1].

For these reasons, the survey was often considered an end in itself research, far from the current conception of the survey intended as a measurement aimed at the critical analysis of the built and philological reconstruction, also environmental. The drawings were therefore linked to that aesthetic conception of the academic drawing.

The twentieth century finally develops interest in the morphological and environmental characteristics

[1] M. Docci Maestri, D.Maestri, *Storia del rilevamento architettonico e urbano*, Ed. Laterza, Roma, 1993.

of urban aggregates, the city is recognized as a cultural, artistic and conceptual environment starting from the conjectural theories of the German school. Numerous European studies are developed focusing on the historical-urban development of cities. In Italy the main exponents of these studies are G. Giovannoni L.Piccinato and L. Quaroni[2].

Writings and research that in exploring the new discipline also attempted to provide a scientific structure, in the lesson of the past, thanks to the historical-structural analysis of the cities.

L. Mumford with the text The culture of Cities, New York, 1938 (Italian translation. The culture of the cities, Milan 1954) highlights the need for an approach on the cognitive value linked to the critical analysis of the historical city. But also the essays by authors such as S. Giedion, Space, *Time and Architecture*, Cambridge (USA) 1941, G. Giovannoni, G. Lugli, V. Mariani, R. Paribeni, C. Pietrucci, L. Piccinato, A. Solmi, *L'Urbanistica dall'Antichità ad oggi*, Florence 1943, by E. Saarinen, The City. Its Growt, its Decay, its Future, New York 1943 and S. Muratori carried more and more the theme for the conservation of ancient cities and the study of research methodology of the sector at national and international level[3].

In this process, the survey is an essential cognitive practice also thanks to the many historical and topographical essays aimed at identifying indications for any hypothetical interventions.

This methodological position definitely denies any validity to empirical procedures based on the artistic culture of Romanticism; instead, it affirms the fundamental objectivity of the systematic investigation practice, at a convincing methodological level because it does not want to be a pedantic philological analysis applied to the urban fabric, but its objective critical evaluation based on real documents, which are the building artifacts that make up the ancient environment.

Therefore, the comprehensive approach to the values of the environment is indispensable, developed through the analysis of all the factors that contribute to its formation and therefore, firstly, through the systematic recognition and objective documentation of all the building structures. pre-existing, which constitute the most conspicuous and metric more consistent aspect of the environment itself.

This process does not end with the simple measurement and graphic representation, but it constitutes only the first and indispensable phase of a wider and more demanding work of critical evaluation of the documented artefacts, during which analyzes must also be conducted on the authenticity of the structures and on the probable transformations undergone over time.

Furthermore, this researches aimed at identifying the recurring building typologies, at recognizing their probable evolution over time, at specifying the significant role they play in the characterized qualification of the urban framework to which they belong, up to the critical evaluation of their irreplaceable value in the context under consideration. .

This is to clarify the reasons why the problem of the systematic survey of the building structures of ancient urban centers spread among not only Italian scholars but also in Germany, where around 1952 studies were carried out on the ancient urban structure and on the evaluation of relationships. between the metric values of the building units and textures of the urban subdivision meshes, but the investigation is still maintained on dimensional and figurative levels, without addressing the

[2] G. Giovannoni , *Vecchie città ed edilizia nuova, Torino 1931;Il quartiere romano del Rinascimento, Roma 1945; Roma dal Rinascimento al 1870,* in: Topografia e Urbanistica di Roma, Bologna 1958;L. Piccinato, Per una tipologia delle città medioevali italiane, Roma 1939; L. Quaroni, L'architettura delle città, Roma 1941.

[3] Saverio Muratori, *Vita e Storia della Città*, in: Rassegna critica di Architettura, n. 11-12 /1950, pp. 3-52

relationships with the structural and typological problems[4].
A need that arose almost simultaneously, and independently both in Italy and in Germany in the same years, that is, in two countries that more than others had suffered from the damage of the conflicts and that, at the beginning of the 1950s, continued to suffer from the serious environmental damage caused by the intense and disordered rhythm with which the building reconstruction took place.

From the Praetorian Tablet to the Digital Cartography

On the basis of the cited historical notions, which have led to consider increasingly detection as a cognitive science that shares interests, research methods and in an increasingly transdisciplinary way, not only as regards the conceptual and theoretical aspects, but also and above all as regards it concerns the historical development and current trends of the science of representation in the territorial, urban and architectural survey.
In the 19th century most of the European States had equipped themselves with specific bodies in charge of carrying out the geometrical classification systematic and regular cartographic survey of the relevant territory, in 1870 Italy formulated a Unified Cartographic Project and two years later the Military Topographical Institute carried out the project of general survey of the Italian territory in scale 1: 100.000. (Topographical Map of Italy).
The survey of the Gran Sasso, carried out by Michele Manzi in 1876 sees the first photogrammetric experiences, but above all the first approach to the use of different instruments - direct and indirect - the Praetorian tablet and terrestrial photographic panoramas with restitution thanks to the perspective rules and geometric proportions, in scale 1: 10,000. (Essay of phototopographicsurvey of the Bart Glacier)
In 1878 the geographic engineer Pio Paganini continued this research activity by creating more and more perfected models of phototopographic instruments for the ground sockets and tools to pass from the measurement of the frame coordinates to the spatial determination of the corresponding point on the ground, the self-restorers were still grounding devices and therefore bound to the frames taken with a horizontal optical axis camera.
In 1924, thanks to Major E. Santoni, a decisive impulse took place and significant developments for the photogrammetric method took place with the study and production of instruments including the photogoniometer and the researcher-triangulator (1925-29); the first phototeodolite (1930) experienced during an expedition in a mountain range in Asia; the ballistic phototeodolites-restitutors (1932) for the Navy and used until 1943; the solar periscope ((1925-26); the stereocartograph model I (1925-26); the stereocartograph model II (1928-29); the stereocartograph Galileo-Santoni model III (1933) and the stereosimplex Galileo-Santoni (1934).
802/5000 In 1938 he presented his experiments in air-triangulation in Rome at the 5th Congress of the International Photogrammetry Society. After a few years of experimentation, in 1929 the production application of the photogrammetric method began, over large areas of the territory, which gave an increasing contribution until the complete replacement of the graphic-numerical practice with the aerial photogrammetric procedure. In 1940, following the developments in the geodetic field, Hayford's international ellipsoid oriented to Rome-Monte Mario was adopted to replace the Bessel

[4] K. Gruber, Die Gestalt der deutschen Stadt, Monaco, 1952.

ellipsoid oriented to Genoa. Furthermore, in 1948, the cartographic projection was also changed: the conformal representation of Gauss-Boaga replaced the polycentric projection of Samson-Flamsteed adopted in 1875[5].
The decisive acceleration of the technological progress of the last thirty years has made available to topographers and cartographers new and powerful means: satellite surveying techniques, methodologies and IT applications, digital procedures for acquiring and processing spatial data.

The national territorial survey system

The Military Geographical Institute (IGM) develops numerical cartography with research-experimentation-production activities aimed at acquiring topographical data by digitizing the stereoscopic model and interactive processing of the same data with consequent automatic drawing of the topographic map through the satellite positioning system global (GNSS), among which the best known is GPS, consisting of a constellation of satellites emitting electromagnetic signals and special receivers positioned on Earth, which detect the three-dimensional positioning of objects.
Satellite topography is a combination of classic topographical techniques, relative measurements of angles and distances made to fixed or moving points that are not invisible on the territory, and satellite navigation systems that directly determine the coordinates, in an absolute reference system.
The aerial photogrammetry products can be processed digital maps of immediate usability, rectified images (orthophotos) and maps derived from them (orthophotos-cards) and databases that constitute the basic structure of Territorial Information Systems (SIT).
Direct photogrammetry, in which no aerial triangulation is necessary, is the latest important development in this field, thanks to the joint use of GPS in determining the position of the camera and inertial sensors (IMU) in identifying the attitude angles .
LiDAR (Light Detection and Ranging) is an aerial detection technique that has the ability to measure the spatial coordinates and the altitude of the points on the ground, by scanning the territory with a laser rangefinder. This allows, in very large areas, the identification, characterization and mapping of the morphologies present, both natural and anthropic, in rapid times and of the highest quality.
The survey by UAV (Unmanned aerial vehicle), commonly known as drone, represents the latest natural evolution, with regard to data processing methodologies and results, of detection techniques carried out with airplanes and helicopters, since it allows to acquire remarkable visual information and geometric in less time and at low cost.
The use of the GPS system that led to the creation of a new national three-dimensional geometric framing network called IGM95.
The national survey system provides for the creation of descriptive images of the earth's surface (Spaziocarta 50S), from satellite digital panchromatic data, which represent a valid supplementary tool of traditional cartography and a solution without alternatives to meet the need to dispose of in a short time. and low cost, of informative representations of the territory; in the construction of territorial information aimed at the formation of a geographic database organized and structured in the logic of an information system (called DB25) whose content, in terms of accuracy and consistency of information, is comparable to that of the topographic map at a scale of 1: 25000 and

[5] https://www.igmi.org/

which, at the same time, allows you to draw up, by extracting the information from the database itself, the associated cartography at the scale 1: 25000 and 1: 50000 which, for uniformity with the reference system WGS84 (World Geodetic System 1984) adopted with the establishment of the IGM95 network is based on the UTM-ETRS89 representation (with the meaning for the second acronym of European Terrestrial Reference System 1989 or the European realization of the WGS84 reference system.

The interdisciplinary system of territory management and tangible cultural heritage.

In the 1980s, at the University of Laval in Canada, the term Geomatics was coined which basically deals with studying, through the interaction of different disciplines, the territory, the environment on a mainly computer and infographics basis.
It presupposes an integrated multidisciplinary approach that selects tools and techniques in the acquisition of mainly metric and thematic data in order to search and archive georeferenced data in digital format.
This method of instrumental interaction is fundamental in the multiscalar approach of the survey. In fact, Geomatics puts in the system all the most up-to-date IT tools of indirect survey and representation, of the analysis of georeferenced data through satellite positioning, digital photogrammetry, remote sensing, SIT also linked to geostatistics and geoservices.
This new discipline defines an advanced multiscale approach for the survey precisely for all the components that determine its effectiveness.
Computer science: science of representation and processing of information applicable through the development of technological tools, hardware, and methods, models and systems, software.
Geodesy: science for determining the shape and size of the Earth, i.e. defining the reference surface in its complete form: the geoid, and in its simplified form: the ellipsoid, and its external gravitational field as a function of time.
Topography: born with Geodesy and inserted in it, it is the set of procedures for the direct survey of the territory. It is entrusted with the studies of the methods and tools to measure and represent in detail the details of terrestrial surface areas in its aspects of: planimetry (to determine the relative positions of the representations of the different points of the ground on the same reference surface); altimetry (determination of the elevation of the points of the earth's surface with respect to the geoid surface); speed-measurement: for the planimetric and altimetric survey of terrestrial surface areas.
Surveying: for the computation of areas, displacement and rectification of boundaries, leveling of areas of the earth's physical surface.
Cartography: provides a possible description of the shape and size of the Earth, of its natural and artificial details, by means of graphic or numerical representation of more or less large areas of the earth's surface according to predetermined rules.
Photogrammetry: science to determine the position and shapes of objects starting from measurements performed on photographic images of the objects themselves.
Remote sensing: remote acquisition of data concerning the territory and the environment as well as the set of methods and techniques for subsequent processing and interpretation (this definition is also suitable for digital photogrammetry).

Satellite positioning systems: allow the three-dimensional positioning of objects even in movement in space and time, on the entire terrestrial globe, in all weather conditions and continuously.
Laser scanning systems: for the identification of objects and the measurement of their distance by using light radiation in a range of the electromagnetic spectrum characteristic of optical frequencies (0.3-15 μm).
Territorial Information Systems (SIT) or Geographical Information System (GIS): powerful set of tools capable of receiving, storing, recalling, transforming, representing and processing spatially referred data. Decision Support Systems (DSS): made up of very sophisticated information systems, capable of creating possible scenarios through the modeling of reality and offering a choice of solutions to the decision maker.
Expert Systems: tools capable of imitating the cognitive processes performed by the experts and their ability to manage the complexity of the real through interdependent processes of abstraction, generalization and approximation.
WEBGIS: for the dissemination of geographic data stored on machines dedicated to the storage of databases, according to very complex network architectures.
Ontology: it is the specification of a conceptuality, that is, the description of the concepts and relationships that may exist for an element or between elements of a group, or entity, or class; conceptualization is an abstract simplified view of the world that you want to represent for a certain purpose[6].

Integrated digital survey systems

The complexity of the acquired data, of the architecture in the environment and therefore in the territory must necessarily be organized, processed, managed, represented in digital cartographies and digital representations and in systems that can be implemented for the control of changes and used in short times for a correct representation and knowledge of the situation not only territorial, but also architectural-urban one.
For these reasons, the new digital survey and representation methods are linked to this complex system: SFM System; laser scanner; drone and GPS.
By “Structure from Motion” we mean a calculation technique that allows you to reconstruct the shape of objects through the automatic collimation of points from a set of photos.
Based on computer vision algorithms, the SfM extracts the remarkable points from the single photos, takes the photographic parameters and crosses the recognizable points on multiple photos, finding the coordinates in the space of the points themselves.
The first calculation process in the SFM software determines the position and orientation of each camera used for the reconstruction of the model, generating a Sparse Cloud that constitutes the set of points useful for aligning the photographs.
This is the first and most important processing in an SFM software, if this step succeeds all the rest will be successful. The second processing consists in the generation of the Dense Cloud, being able to parameterize the creation of a cloud with the highest number of points.

[6] Gomarasca, Mario A., *Elementi di geomatica*, Firenze, Associazione Italiana di Telerilevamento, 2004.

The third elaboration, is a generation of a triangulated mesh, with a mesh density relative to the number of points calculated in the dense cloud.
The coloring of the Mesh will be carried out using the average RGB value of the three coordinates that form the triangle.
The fourth processing is the generation of a high resolution texture.
The coloring of the Mesh will be carried out by applying the entire photographic texture of the images useful to the object of interest. Laser scanners are instruments capable of measuring the position of hundreds of thousands of points that define the surface of surrounding objects at very high speed. The result of the acquisition is a very dense set of points commonly called "point cloud". We can define laser scanners as direct measurement systems allowing to obtain measurements related to an instrumental precision defined by a calibration certificate.
There are several useful parameters for defining and evaluating the characteristics of a laser scanner instrumentation: range (maximum distance that the scanner is able to measure); speed (number of points acquired in each second); precision (ability of the instrument to return the same value in subsequent measurements); laser class (the danger of the laser beam emitted by the instrument), from class 1 (completely harmless) to class IV (very dangerous) and integrated devices (possibility of integrating other software or devices).
Basically there are 3 measurement principles with laser scanner: TOF (time of flight) laser scanner, phase difference laser scanner and triangulation laser scanner.
In TOF (Time Of Flight) laser scanners, the distance is calculated by measuring the round trip time of the laser pulse sent. In phase difference laser scanners, the distance is calculated by comparing the phase difference between the emitted and received waves.
Triangulation laser scanners have a technology that is based on the acquisition by an IP sensor of a pattern of infrared points in a given space.
At the application level, integrated surveys have been developed on the San Silvestro complex, currently the headquarters of the Architecture and Design Department of Genoa.
The tools used were:
- 3D EYE TELESCOPIC POLE with SONY A5100 24 Mpx camera for taking photos up to 10 meters high;
- DRONE DJI SPARK < 300 g for roofing and bell tower ;
- GPS GEOMAX to scale and georefer the model;
- LASER SCANNER FARO S70 to achieve sub-centimeter accuracy
- REFLEX CAMERA for photos from the ground.

All the photos were imported into the 3DF Zephyr Aerial photogrammetric software which generated the 3D model of the Pieve in a completely automatic way through four steps: Sparse reconstruction- Dense reconstruction- Mesh generation- Texture application.
The model was scaled and georeferenced within 3DF Zephyr by loading the x, y, z coordinates of the targets hit the ground with a GPS instrument.
The precision of the points was subsequently improved by aligning the photogrammetric point cloud with the laser scanner scans, reaching accuracy levels below the centimeter.
This system allows, from the 3D model, to extract 2D floor plans of the entire complex and high resolution orthophoto.

Images referring to 3d eye telescopic pole, drone dji spark Microgeo; gps laser scanner faro s70 Geomax.

Conclusions

Reading comprehension of such dispersive phenomenon, the research is linked to the old problem of urban planning responsibilities, one wonders what the agents to identify, analyze and represent in order to carry out qualitative and therefore "resilient" interventions.
The design of the city is also a philological interpretation of narrative that provides new methodological approaches, not least thanks to innovative information networks and processing of sources that the digital revolution has introduced into operation the analysis of complex systems that require interdisciplinary connections.
Management of graphic data, the purposes of computer graphics digital systems in the representation of environment (relational reality), landscape (perceived reality) and architecture (objective reality).
The construction of a three-dimensional virtual model offers the possibility, through visual characterizations such as shadows and sunshine, to get closer and closer to the human perceptual system, making it possible to immediately communicate complex information concerning the territory and architectural volumes in an urban space.
The representation system thus becomes capable of illustrating the relationships between form and measurement in the scales of a territory or in an urban space, restoring an ease of understanding and interpretation of even very complex technical maps.
In this context, the simplification made to the system of representation of the territory offers the possibility of adding analytical information, without interfering with the ease of reading the geographical context.

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In Sharing the positions expressed in the article, the result of common theoretical approaches and elaborations, the themes: "Survey Interdisciplinary methodological principles" , "The interdisciplinary system of territory management and tangible cultural heritage" and "Conclusion" are attributed to Giulia Pellegri; "The national territorial survey system" and "Integrated digital survey systems" are attributed to Francesca Salvetti.

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