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Hyperspectral sensors and the conservation of monumental buildings

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The continuous control of the conservation state of outdoor materials is a good practice for timely planning conservative interventions and therefore to preserve historical buildings.
The monitoring of surfaces composition, in order to characterize compounds of neo-formation and deposition, by traditional diagnostic campaigns, although gives accurate results, is a long and expensive method, and often micro-destructive analyses are required.
On the other hand, hyperspectral analysis in the visible and near infrared (VNIR) region is a very common technique for determining the characteristics and properties of soils, air, and water in consideration of its capability to give information in a rapid, simultaneous and not-destructive way.
VNIR Hypespectral analysis, which discriminate materials on the basis of their different patterns of absorption at specific wavelengths, are in fact successfully used for identifying minerals and rocks (1), as well as for detecting soil properties including moisture, organic content and salinity (2).
Among the existing VNIR techniques (Laboratory Spectroscopy - LS, Portable Spectroscopy - PS and Imaging Spectroscopy - IS), PS and IS can play a crucial role in the characterization of components of exposed stone surfaces. In particular, the Imaging Spectroscopic (remote sensing), which uses sensors placed both on land or airborne, may contribute to the monitoring of large areas in consideration of its ability to produce large areal maps at relatively low costs.
In this presentation the application of hyperspectral instruments (mainly PS and IS, not applied before in the field of monumental building diagnostic) to quantify the degradation of carbonate surfaces will be discussed. In particular, considering gypsum as the precursor symptom of damage, many factors which may affect the estimation of gypsum content on the surface will be taken into consideration.
Two hyperspectral sensors will be considered:
1) A portable radiometer (ASD-FieldSpec FP Pro spectroradiometer), which continuously acquires punctual reflectance spectra in the range 350-2500 nm, both in natural light conditions and by a contact probe (fixed geometry of shot). This instrument is used on field for the identification of different materials, as well as for the definition of maps (e.g geological maps) if coupled with other hyperspectral instruments.
2) Hyperspectral sensor SIM-GA (Selex Galileo Multisensor Hyperspectral System), a system with spatial acquisition of data which may be used on an earth as well as on an airborne platform.
SIM-GA consists of two electro-optical heads, which operate in the VNIR and SWIR regions, respectively, between 400-1000 nm and 1000-2500 nm (3).

Although the spectral signature in the VNIR of many minerals is known, the co-presence of more minerals on a surface can affect the quantitative analysis of gypsum. Different minerals, such as gypsum, calcite, weddellite, whewellite, and other components (i.e. carbon particles in black crusts) are, in fact, commonly found on historical surfaces. In order to illustrate the complexity, but also the potentiality of hyperspectral sensors (portable or remote sensing) for the characterization of stone surfaces, a case study, the Facade of Santa Maria Novella in Florence – Italy, will be presented.

References

1) R.N. Clark and G.A. Swayze, 1995, “Mapping minerals, amorphous materials, environmental materials, vegetation, water, ice, and snow, and other materials: The USGS Tricorder Algorithm”, in “Summaries of the Fifth Annual JPL Airborne Earth Science Workshop”, JPL Publication 95-1,1,39-40
2) E. Ben-Dor, K. Patin, A. Banin and A. Karnieli, 2002, “Mapping of several soil properties using DATS-7915 hyperspectral scanner data. A case study over clayely soils in Israel”, International Journal of Remote Sensing, 23(6), 1043-1062
3) S. Vettori, M. Benvenuti, M. Camaiti, L. Chiarantini, P. Costagliola, S. Moretti, E. Pecchioni, 2008, “Assessment of the deterioration status of historical buildings by Hyperspectral Imaging techniques”, in Proceedings of the “In situ Monitoring of Monumental Surfaces –SMS/08” Congress, Edifir-Edizioni Firenze 2008, 55-64