IS THERE A UNITARY PERSPECTIVE FOR DATA ANALYSIS IN GEOSCIENCES ?

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ABSTRACT

This paper briefly review the past and the present relationships between Geodesy, Surveying and Photogrammetry.

The connections among these sciences are analysed from the methodological point of view, trying to find common backgrounds which can form a basis for future interactions.

Geodesy, Surveying and Photogrammetry are research fields that were strictly entangled in the past.

Geodesy and Surveying were related through the description of the figure of the Earth which is investigated on a global basis in Geodesy and on local areas in Surveying.

Surveying and Photogrammetry were tied together through Cartography to the analytical representation of the Earth surface.

The higher level of connection between these research fields was reached in the seventies with the theory of Integrated Geodesy and with the block adjustment method which created a deep interaction among gravity field, positioning and Earth surface representation through images.

This connection was methodologically based on the theory of Least Squares which was the common tool largely used in Geodesy, Surveying and Photogrammetry to get parameter estimates.

However, in the last two decades this integration process has reverted and these scientific disciplines have become more and more different both in methodologies and applications.

Particularly, Geodesy and Photogrammetry seem nowadays sharply separated on a logical ground.

Geodesy is mainly devoted to gravity field estimation both on a local and on a global basis.

New global geopotential models have been developed up to degree and order 360 and detailed geoid estimates have been derived in local areas.

Furthermore, the geodetic satellite technique based on radaraltimetry has enormously improved the global data coverage on sea and planned gradiometric missions will hopefully allow a very detailed description of the Earth gravity field.

This research direction led Geodesy to a close connection with both pure and applied Geophysics due to the common interest of these disciplines in the gravity field of the Earth.

Modern Photogrammetry is related to digital image processing and digital photogrammetry is nowadays the core of Photogrammetric researches.

Digital cameras became available and largely used since the early nineties; so Photogrammetry became more and more connected to computer vision science, sharing with it problems and methods such as pattern recognition, image understanding and so on.

Hence, today, Geodesy and Photogrammetry are quite far apart and Surveying which was formerly the bridge between the two is no more able to connect these sciences together.

At the same time, the common statistical background, i.e. the theory of least squares, is not anymore sufficient to glue in an effective way such different research fields and so, it seems that no interaction exists among them as it was in the past.

However, to a deeper insight, one can doubt of that.

Are the used methodologies so sharply different? Isn't there a common background not necessarily based on least squares?

One can try to ask these questions evaluating more closely the different objects which are studied in these sciences and the used analytical tools.

It is for sure that remarkable differences exist at least at the level of the signal under investigation.

The gravity field is intrinsically smooth while an image can be extremely rugged (one however should remember that DTMs are also used extensively in Geodesy and that these fields can be rugged too).

Although the signals which must be handled are remarkably different, there are common problems which are analysed with statistical methods that are quite close each others.

The definition of internally homogeneous areas and their contours in digital images is a relevant problem which is becoming more and more important also in Geodesy.

While in Photogrammetry one tries to select areas having common features, in Geodesy this concept can be applied to the gravity field to get areas which display peculiar behaviours connected to some geological structures.

Filtering is also a common problem. Both Fast Fourier Techniques and Wiener filtering techniques (e.g. Collocation) are applied in Geodesy and Photogrammetry.

In particular, Wiener filtering methods are widely used in Geodesy while up to now they gave quite poor results in Photogrammetry, probably due to a too simplistic

approach (in Photogrammetry the concept must be introduced of non stationary filters).
Finally, the inversion of a smoothing operator is performed both in Geodesy and Photogrammetry.
The downward continuation problem as applied e.g. to the gravity field and the deblurring in image analysis are two examples of such kind of problem.
Even if in the two research fields different techniques are applied to invert smoothing operators, the basic idea is the same, i.e. to find an estimator which is "close" (in some norm) to the observations and which is properly stabilised using the Tikhonov method.
So, in conclusion, from this short discussion it comes out that Geodesy, Surveying and Photogrammetry are not so far apart and that it is now time to establish new contacts among them to share common theoretical methods and numerical tools.