

## ABSTRACT

The development of the cartographic recovery procedure presented in this thesis was started by the need of the Valencia Council to make use of the urban map of 1929 as a tool for territory conflict resolution. Its patrimonial and historical values make the digitization with colorimetric profiling an essential effort for conservation and reproduction purposes as well as for its integration in the municipal geographical information system. The first chapter briefly describes the aims of the research, the state of the art together with previous research on the subject, and also establishes an introduction to urban cartography.

Chapter two focuses on the original documents related to the urban map survey with the purpose of performing an in-depth analysis of every stage of the computation procedure. With this goal in mind, calculations have been rerun both with modern computing tools as well as with the original calculation techniques with the aid of the bibliographic references of the time.

The third chapter intends estimating the technical quality of the surveying triangulation network observed in 1929 and checking the expected accuracy considering the map scale. With this objective, a Gaussian network adjustment using the so-called coordinate increment method is applied, and a complete error analysis is obtained. The last section in this chapter explores the application of the two order design problem (PD2) in the adjustment, providing significant advantages in the interpretation of results. From this historical-technical research, some conclusions are drawn about the quality of the present cartographic source and the beginning of the second phase of research starting in the fourth chapter is justified.

The fourth chapter introduces two objectives. The first one is to perform the georeferencing procedure using GNSS measurement techniques of matching

points together with a two dimensional 2D affine transformation for representing the map on the ETRS89 reference system and the UTM projection system. The second is to adjust a series of networks, whose vertexes are part of the network surveyed in 1929, according to the Gaussian method of coordinate increment adjustment which provides rigorous interpretation of the results. It also establishes error figures both geometrically and probabilistically by means of multivariate analysis based on the theory of pedal and hyperpedal curves.

Chapter five studies the evolution of a micro geodetic network over time, defining and evaluating possible deformations that could occur and affect it. In this context, “deformation” refers to the differences between the georeferenced cartography of 1929 obtained with our procedure with respect to modern official reference systems. The results are obtained in the form of a deformation vector. The vector elements, quantifies numerically the variation of each one of the net coordinates on a vertex by vertex basis. The establishment of a threshold allows the discrimination of the results obtained by different procedures, studying and assessing the statistical power about the results as a whole or in isolated areas by means of multivariate analysis. Furthermore, it is possible to make a rigorous virtual densification of the net with the same level of accuracy as provided from observation and direct calculation. In order to complete the previous work, the topic of dividing the network is developed which gives total control of it either in arbitrary areas or even vertex by vertex. The procedure allows one to identify and isolate specific areas making it possible to draw conclusions about the predictable evolution of the deformation vector through periodical observation campaigns and adjustments of the individual areas without modifying the prior condition of invariance. Therefore, this methodology is applicable to the study of areas of different importance, and allows reaching optimum results with a local

transformation that significantly improves those results.

Finally, the sixth chapter collects the conclusions and some reflections that are considered in the discussion. The chapter ends with a list of future research lines that could follow this thesis.

The research closes with four appendices. The first one collects the theory named as areas of different importance that was applied in the fifth chapter: The second one contains some the details of the geometric method based on circumscribing circles that was used to obtain the best results in the georeferencing of the map, which has the advantage of avoiding stations in vertexes with difficult access. Third one develops the maps acquisition in digital format, and the last one is reserved for the programming and work integration in a GIS environment.