# Design, establishment, analysis and quality control of a high-precision reference frame in Cortes de Pallás (Spain)

Luis García-Asenjo[1], Laura Martínez[2], Sergio Baselga[1], Pascual Garrigues[1], Raquel Luján[1]

[1] Department of Cartographic Engineering, Geodesy and Photogrammetry, Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia, Spain (lugarcia@cgf.upv.es; serbamo@cgf.upv.es; pasgarta@cgf.upv.es; ralugar@cgf.upv.es)

[2] Department of Roads and Infrastructures, Diputació de València, c/ Hugo de Moncada, 9, 46010 Valencia, Spain, (laura.martinez@dival.es)

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**ABSTRACT**

A high-precision geodetic reference frame was required in Cortes de Pallás (Spain) to undertake a long-term deformation monitoring project. Involving distances up to 2000 m, the aimed accuracy was 1 mm and 3 mm for horizontal and vertical components, respectively. Such a high precision is necessary to detect possible displacements of selected points on a critical rocky area in a short period of time, *i.e.* two or three years, and also to provide ground control for the integration of precise 3D models periodically obtained by remote sensing techniques. Considering the historical geotechnical problems of the area, the possible influence of the hydroelectric power plant, and the peculiar orography of the zone, a proper analysis of the stability is crucial if the reference frame is to be used for rigorous over-time deformation monitoring. This paper describes the deformation monitoring of a 10-pillar geodetic network which was measured from 2018 to 2020 by using a sub-millimetric Mekometer ME5000 (0.2 mm + 0.2 ppm) along with a demanding observing methodology which includes a network of data loggers for temperature, humidity and air pressure as well as proper calibration of sensors and instruments to prevent potential inconsistencies between the scale of the network and the unit of length of the International System (SI-metre). The results demonstrated that the chosen methodology yielded the aimed accuracy. However, using such a high precision methodology entails the problem that small displacements of only one or two millimeters are significantly detected as deformations by conventional deformation analysis and then it arises the problem of finding a subset of stable points for a rigorous datum realization when all the points seem to displace. This general problem is analyzed in the particular case of Cortes de Pallás, where a balanced mix of deformation analysis and technical decisions was eventually adopted to define a precise and stable reference frame for rigorous over-time deformation monitoring.

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