Bidimensional regression: a novel algorithm for the computation of a viewing point in space based on the relation between the 2D projective transformation and space resection

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Mental maps, implying the comparison between a real-world and a mental spatial configuration, have been widely studied both in geography and psychology. One method for analyzing them is bidimensional regression, which Tobler introduced as a means to compare the similarity between two sets of two-dimensional data in relation to four transformation models: euclidean (similarity), affine, projective, and curvilinear [5]. The euclidean, affine, and curvilinear transformations have been explored to some extent [1, 2], while the projective transformation (P) has been given little attention. P is related to space resection (R), i.e. the computation of a viewing point in space [4]. So far, however, no contribution has explicitly shown the link between P (8 parameters) and R (9 parameters). The 9 parameters of R are composed of 3 interior-orientation parameters (IOPs) and 6 unknown exterior orientation parameters (EOPs), and to date, solutions for R have all assumed prior knowledge of the IOPs [3]. Building on Seedhamed's work [3], this contribution presents a novel algorithm for the retrieval of the EOPs without prior knowledge of the IOPs, which is the case when dealing with mental maps. The solution requires giving a fixed value, say unity, to the principal distance, one of the IOPs, and exploiting 6 of the 8 parameters of P to form a system of two equations resulting in a quartic equation ($\alpha x^4 + \beta x^3 + \chi x^2 + \delta x + \varepsilon = 0$). Solving this system leads to the direct computation of the IOPs and EOPs. The validity of the algorithm is shown through numerical examples based on urban mental maps.

References

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