Nonlinear Continuous Deformation of an Image Based on a Set of Intersecting Straight Lines

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Summary

The problem addressed by this team was proposed by Matrox Electronic Systems. Let I be a closed area within the plane, i.e., an image, which can be assumed to be a rectangle. Let D_i be a set of equidistant points belonging to a straight line and included in I. Let $A = \{D_i \mid i = 1, 2, \ldots, M\}$ be a collection of M straight lines belonging to the same plane (i.e., all points in $\bigcup_{i=1}^{M} D_i$ belong to the same plane). Some of the intersection points of lines in A may belong to I. Finally, let $g(x, y)$ be a function from the plane into itself representing a nonlinear, continuous, and smooth deformation of I. Given the image under g of the union of all the D_i, the problem is to find a method for estimating g. The function g to be estimated represents the nonlinear image deformation produced by the lens of a camera.

The problem just described arises in camera calibration but has features that set it apart from the problems considered so far in the literature. Indeed, the original points and the relative positions of the lines are unknown, and in most cases, the set $\bigcup_{i=1}^{M} D_i$ is not dense in the plane containing the lines. The members of the team proposed several approaches for solving the problem, and we refer the reader to the presentation on the web site of the workshop. Some team members pursued their work and submitted an article that has now been accepted. The reference is the following: *Nonlinear Continuous Deformation of an Image Based on a Set of Coplanar Straight Lines - A Two-Stage Camera Self-Calibration Procedure*, by P. Armand, A. Kiselev, O. Marcotte, D. Orban, V. Zalzal, to appear in the electronic journal **Mathematics-in-Industry Case Studies** (cf. the site http://www.micsjournal.ca/index.php/mics).

Acknowledgements

The team members are very grateful to Arnaud Lina, from Matrox Electronic Systems, for proposing this problem.