Andrea Fusiello
Department of Electrical, Management and Mechanical Engineering
Universita' degli Studi di Udine, Italy

"AUTOMATIC IMAGE ORIENTATION: IS EVERYTHING SOLVED?"

Not surprisingly the answer depends from the scale at which one examines the question. At a coarse scale the problem can be declared solved. It has a long history, that dates back at least to Lagrange, who solved space resection in 1795. We know minimal solvers for all the orientation problems (relative, exterior, absolute), together with their critical configurations. We know Gauss-Markov estimates for the overdetermined case, and most of all, we can choose among many off-the-shelf software that does the job automatically and reliably (often as a black box, though).

However, at a closer look, one can spot some new issues that pose challenging and thought-provoking problems to the photogrammetry and computer vision communities (or, maybe, it is time to start referring to it as the "photogrammetric computer vision" community). Two of them arise from a departure from the central projection model, namely non-central and rolling shutter cameras. In non-central cameras the projection rays do not intersect in a single point; they can model both catadioptric cameras and multi-camera systems. The rolling shutter effect is typical of low-cost CMOS cameras, and produces images where every column is acquired at a different time instant, like in a pushbroom camera.

These last two issues stem from a change of perspective on something we are accustomed to: orientation is computed from points (or, dually, lines). Wrobel, back in 2001, advocated for using all the gray values of the images in the process of orientation: "Perhaps this new mathematical basis of digital photogrammetry might replace in the future the orientation procedures we favor now." This revolution has still to come, though.

More recently a new research line in image orientation discards the points in the block adjustment phase, aiming at the so-called structure-less bundle adjustment, where the problem is expressed through epipolar and scale consistency constraints that are free of object space coordinates. This is linked to the group averaging or synchronization concept that is being exploited effectively in several computer vision and photogrammetry tasks.