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Short title: Omnidirectional robot vision using conformal geometric computing.

MR Number: 2286447

Primary classification: 68T45

Secondary classification(s): 15A66, 51N15, 68T40, 68T10

Review text:

This paper is of interest to students and researchers in camera geometry, computer vision, robotic navigation and object recognition.

The work is relatively self-contained. It first gives a standard introduction to *Clifford geometric algebra* (GA), including GA of projective spaces and *conformal GA*. Conformal GA embeds $\mathbb{R}^3$ in $\mathbb{R}^{4,1}$, null vectors are assigned to origin and infinity, and all conformal points lie on the intersection of the 4D null cone with a hyperplane. Outer products of conformal points lead to *outer product null space representations* of point pairs, circles, lines, spheres and planes. Both rotations and translations become elements of the *Clifford group* (represented as *versors* $M =$ geometric products of vectors) in the general form $X' = MX\widetilde{M}$ (in $\widetilde{M}$ the order of vector factors is reversed).

In conformal GA exists a *unified catadioptric camera model* consisting of: (1) a sphere S (center C) onto which 3D object points are first centrally projected, and (2) a second center of projection point N, projecting points from the sphere to the the catadioptric image plane (perpendicular to the line NC). The projections of 3D object points in this unified model to the catadioptric image plane (and vice versa) can be easily expressed in conformal GA.

The central projection of 3D object points onto the sphere S preserves projective invariants called cross-ratios. Expressing these cross-ratios in conformal GA provides the geometric tools for object recognition, robot navigation and object tracking. Algorithms and examples of these applications are explained and illustrated with actual experiments. The discussion includes the angular error, and the influence of noise.