3D Depth Mapping Vision System Worthy of an Extraterrestrial

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One of the biggest factors holding intelligent robots back from becoming part of our lives is the difficulty they have navigating the complex and unstructured 3D spaces we live in. This is because robotic depth mapping cannot compete with basic human spatial intuition. Two vision systems that require only easily accessible cameras are optical flow, which calculates the distances to objects based on the relative flow of pixels between successive frames of a video, and stereo vision, which uses two cameras to determine the distance by calculating the difference in pixel positions in two cameras. Previous research showed that the special case of an optical flow camera traveling with perfectly linear motion is a viable alternative to standard stereo vision systems for robotic depth mapping. This result, while exciting, is not practical because of the linear motion constraint. This current research builds on this special case by introducing rotational velocities in order to overcome this constraint. In order to achieve this, a mathematical model that compensates for rotation was created based on the physics of optics to account for the complex and non-linear transformation. The final results show that this general form of optical flow is competitive with, or superior to, existing stereo vision setups in most practical cases when the ratio between rotational and linear velocity is small. Furthermore, the unique advantages of optical flow depth mapping, primarily the lowered cost and complexity and ability to refine distance measurements over time, were maintained in the general optical flow case.

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