Real-time Low-Cost Omni-directional Stereo Vision via Bi-Polar Spherical Cameras
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**Issue:** omni-directional dense stereo vision, based on imagery from two consumer-grade spherical cameras mounted in a novel bi-polar configuration.

**Hardware:**

A novel bi-polar camera configuration (above) and on-vehicle mounting (below) overcomes the left to right inter-occlusion issues of previous work \cite{1}.

**Spherical Camera Model:**

Calibration via \cite{2} extracts the spherical camera intrinsics, \(\xi, K, D\), and inter-camera extrinsics. Consideration of similar triangles allows recovery of depth \(Z\) for a point \(P\) in the scene. (full proof presented in paper)

\[
Z = \rho_{N} \sin(\phi_{N}) \cos(\theta_{N}) = \rho_{N} \sin\left(\frac{v_{N}}{f_{s}}\right) \cos\left(\frac{u_{N}}{f_{s}}\right)
\]

where \(\rho_{N}\) is the baseline between the two camera centres, \(f_{s}\) is the radius of the sphere used in the spherical camera model, \(u\) and \(v\) are the horizontal and vertical pixel coordinates respectively, with subscripts \(N\) and \(S\) representing the camera positions.

**Performance:** real-time 360° stereo depth recovery achieved at 5.5 fps with a \(\sim 0.4\) pixel calibration error.

\cite{1} Matzen, Cohen, Evans, Kopf, Szeliski. Low-cost 360\degree stereo photography and video capture. ACM ToG, 36(4):1–12, 2017.
