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Wide angle mirror system design for distortionless imaging of the sky

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Imaging using all-sky lenses of 180° field of view has a long tradition in atmospheric airglow and auroral science. For a vertically mounted camera, the traditional fish-eye lens systems are linear in local zenith and azimuth angle. Hence, they introduce significant radial distortion, especially toward the horizon of the image. Fish-eye optics can be easily implemented using a single convex mirror or a pair of convex mirrors. A novel convex mirror shape that removes the fish-eye distortion from the image and keeps fixed resolution over the entire sky at a chosen altitude (e.g., 100 km) was developed in the early 90s. However, the local sky zenith in the image is blocked by the camera itself as it is situated looking down onto the mirror. We have solved this problem by using two convex mirrors with special profiles. However, this convex mirror system suffers from significant focusing issues. We use Snell's law of reflection, simple mathematics and straight-line ray tracing to design a corrected wide angle mirror system using two concave mirrors. The design provides a real time achromatic transform while implementing a uniform spatial sky resolution and optimizing focus throughout the field of view.

Apply to be considered for a student award (Yes / No)?

No

Level for award (Hons, MSc, PhD, N/A)?

N/A

Would you like to submit a short paper for the Conference Proceedings (Yes / No)?

No

Primary author: VANWINGEN, Hanna (University of Michigan, USA)

Co-authors: Dr MOLDWIN, Mark (University of Michigan, USA); Prof. KOSCH, Michael (SANSA)

Presenter: VANWINGEN, Hanna (University of Michigan, USA)

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