Open Internship in the ESA Advanced Concepts Team in 2014

on

Bio-inspired depth perception by image defocus for landing applications

Topic Description

Jumping spiders are considered to have the best vision among invertebrates - used for hunting, courtship and navigation. During hunting, spiders attack by jumping on their prey accurately, inserting their fangs and injecting a rapidly acting venom. This sequence happens in less than a second. To make this method successful, the spider needs to determine the distance to its prey very accurately.

Recently it has been found that accurate distance measurement is possible through the anterior median eyes (AME) by using image defocus cues for very accurate depth perception. The principal eyes of a jumping spider use one lens system with four photo-receptor layers. Chromatic aberration of the lens ensures that the light of different wavelengths is focused on the corresponding receptor layers. The two deepest layers have receptors for green light and thus one projection must be blurry. Nagata et al. [1] show that the defocused image on the deepest layer is used for depth perception. Inspired by the jumping spider visual apparatus, we will investigate a simple monocular vision based distance sensor for autonomous spacecraft decent.

Candidate's tasks

The successful candidate will set up a test environment to create a database of (defocused) images of a target location at different distances. Then he/she will investigate different algorithms to create a mapping from defocus level to height above ground (see [2,3]).

The ideal candidate

- Excellent programming skills (C++ or Python is required, OpenCV is a plus)
- Knowledge of classical optics

References

[1] Nagata, Takashi, et al. "Depth perception from image defocus in a jumping spider." Science 335.6067 (2012): 469-471. [1]

[2] Chaudhuri, Subhasis, A. N. Rajagopalan, and S. Chaudhuri. Depth from defocus: a real aperture imaging approach. Vol. 3. New York: Springer, 1999.

[3] Saxena, Ashutosh, Min Sun, and Andrew Y. Ng. "Make3D: Depth Perception from a Single Still Image." AAAI. 2008.