Neuromorphic Computation of Optic Flow Data

Executive Summary

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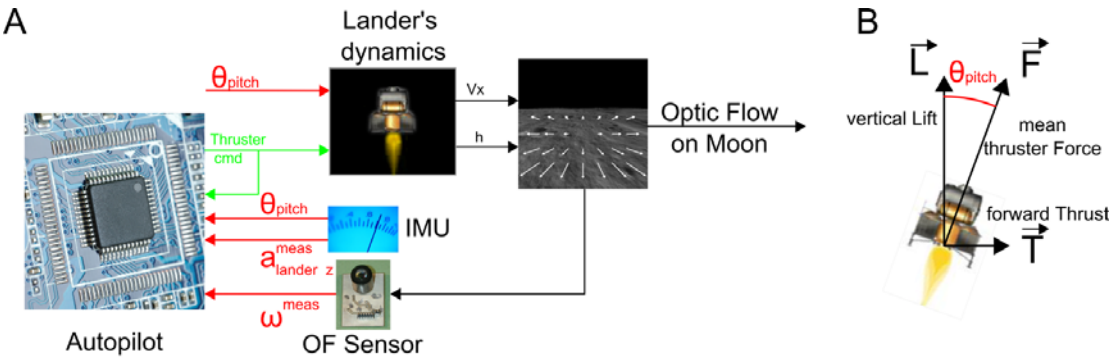
Picture:



Motivation:

Flying insects excellently master visual motion sensing techniques coping with highly parallel data at low energetic. Results from neurophysiolgical, behavioural, and biorobotic studies on insect flight control were used to attempt safe landing of a spacecraft on Moon in a realistic simulation environment.

Methodology:

Autonomous landing on unknown extraterrestrial bodies requires fast but noise-tolerant motion processing to elicit correct steering commands. Flying insects excellently master visual motion sensing techniques coping with highly parallel data at low energetic cost, by employing dedicated motion processing circuits. Biomimetic optic flow-based control strategies for automatic landing were simulated in a very realistic environment of the Moon. Visual information were provided by PANGU software and used to regulate the optic flow (OF) generated during the landing phase of a two degree of freedom spacecraft.

Results:

It was shown that automatic lunar landing is suitable using neuromorphic OF measurement without any need for measuring speeds and altitude. In addition, the suggested control system is :

- Robust to different initial conditions
- Robust to low solar elevation
- Robust to a temporary absence of OF measurements

Publications:

Valette, F., Ruffier, F., Viollet, S., Seidl, T., Submitted
“Biomimetic optic flow sensing applied to a lunar landing scenario”,
IEEE International Conference in Robotics and Automation, ICRA 2010,
Anchorage, USA.

Highlights:

We have shown that the OF regulator aims at holding the perceived OF close to a previously chosen set point by acting upon the mean thruster force of the lander. As a result, it was shown that the lander’s ground speed and vertical speed decrease automatically all along the landing phase thank to the optic flow regulation. Thus, the biomimetic autopilot presented here allows the lander to reach low gate at low forward and descent speeds.