Inspired by Elephants and Bees: Navigation and Water Detection with MicroElectroMechanical Systems (MEMS)

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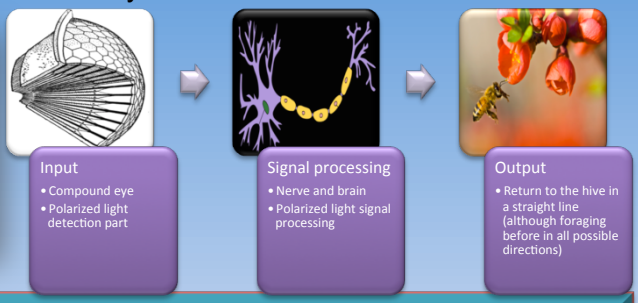
How to Navigate without GPS?

Learn from Nature's navigators (bees, ants, migrating birds, …)

Rayleigh sky model: Polarization pattern of the daytime sky

Honeybee Navigation

- Honeybees detect polarized skylight with their compound eyes.
- They navigate using the polarization pattern of the sky, that changes throughout the day.



Bio-inspired polarized light-based MEMS navigation device

Biomimetics: Knowledge transfer from biology to engineering, resulting in novel innovative technologies

MEMS Device Concept

1. The MEMS sensor array is inspired by abstractions of the respective biological functions: polarized skylight-based navigation sensors in honeybees (*Apis mellifera*) and the ability of African elephants (*Loxodonta africana*) to detect water.
2. The polarization-detection device uses light beam reactive MEMS, which are capable to sense the skylight polarization based on the Rayleigh sky model. For water detection we present various possible approaches to realize the sensor: polarization and infrasound-based ones, for localization of underground rivers and visualization of their exact routes.

Research Achievements

Winner of the 2012 AGSE Innovation Award in Recognition of Outstanding Achievements in the Field of Applied Geoinformatics

Q1 ISI Publication -SENSORS 2012-
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Bioinspired Water Detection with MEMS

Elephants locate underground rivers 14.3 km away and 3 m underground (with infrasound sensors)

Bees sense slight changes in polarization induced by water vapor

Bioinspired MEMS water detector for desert survival

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The National University of Malaysia funded part of this work with its leading-edge research project scheme 'Arus Perdana' [UKM-AP-NBT-16-2010].

Further Reading

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