

Biomimetic Nanoscience Inspired by Elephants and Bees: Water Detection with MEMS



How to Find Water?

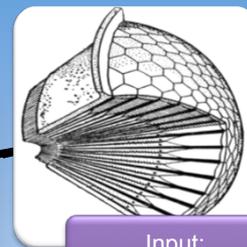


Learn from animal
senses and sensors



Honeybee Polarization Vision

Honeybees detect polarized skylight with nanoscale sensors in their compound eyes for navigation (the polarization pattern of the sky changes throughout the day) and water detection.



Input:
Compound Eye
Dorsal Rim Area



Output:
Navigation
Water Detection

Bio-inspired water
detection with
MEMS

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

Bioinspired Water Detection with MEMS

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



Bees sense
slight changes
in polarization
induced by
water vapor

Bioinspired
MEMS water
detector for desert
survival

MEMS Device Concept

1. The MEMS sensor array is inspired by abstractions of biological functions: polarized skylight-based navigation sensors in honeybees (*Apis mellifera*) and the ability of African elephants (*Loxodonta africana*) to detect water.
2. Three approaches are combined to realize the sensor concept: A biomimetic polarization-detection device that uses UV sensing to sense changes in moisture content of the air, and infrasound- and infrared based ones, for localization of underground rivers and visualization of their exact routes.

☺ Detects Water in Unusual Places ☺



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Further Reading

- Makarczuk T., Matin T.R., Karman S.B., Diah S.Z.M., Davaji B., Macqueen M.O., Mueller J., Schmid U. and Gebeshuber I.C. (2011) "Biomimetic MEMS to assist, enhance and expand human sensory perceptions: a survey on state-of-the art developments", Proc. SPIE 8066, 80661O(15p).
- Karman S.B., Diah S.Z.M. and Gebeshuber I.C. (2012) "Bio-inspired polarized skylight-based navigation sensors: A review", Sensors 12(11), 14232-14261.
- Futterknecht O., Macqueen M.O., Karman S., Diah S.Z.M. and Gebeshuber I.C. (2013) "Biomimetic MEMS sensor array for navigation and water detection", SPIE Microtechnologies, Grenoble, France, April 24-26, 2013.

Acknowledgement

Partly funded by the Government of Malaysia via FRGS/1/2013/TK02/UKM/01/1.