

The “navigation sense” in living nature: A survey for engineers

S. Zaleha M. Diah¹, Salmah B. Karman^{1,2}, O. Futterknecht³, Ille. C. Gebeshuber^{1,3}

¹Institute of Microengineering and Nanoelectronics, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Malaysia;

²Department of Biomedical Engineering, Faculty of Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia;

³Institute of Applied Physics, Vienna University of Technology, Wiedner Hauptstrasse 8-10/134, 1040 Vienna, Austria.

Corresponding Author’s email: musnaliza@yahoo.com

Biomimetics is synonymous with or biologically inspired and bioinspired. In biomimetics, materials, processes and systems in nature are analysed, the underlying principles are extracted and subsequently applied to science and technology. Once the basic principles of the biological system are understood, the engineer can start to work on the related bioinspired device. Many animals use combination strategies to orient themselves, and to navigate. They use long-distance and/or short-distance clues to forage and orient themselves to return back to their nest or hive, sometimes for kilometres. Famous navigators from the animal world including the honeybee (*Apis mellifera*) and the desert ant (*Cataglyphis bicolor*). Both use polarization-based navigation. The ants became model organisms for engineers on how they find their way back. Neurobiological and behavioural research yielded a model that was adapted for robot navigation. The skylight pattern of polarised light (the e-vector pattern) provides one of the cues for navigation. A specialized part of the insect compound eye has a small group of ommatidia and is located in the dorsal rim area. These detect the polarised light. Each ommatidium contains two photoreceptors and is strongly polarization sensitive, with orthogonally arranged analyzer direction. Understanding the theory of the mechanism behind polarised light detection and subsequent navigation in insects is important in the development of a microelectromechanical MEMS based navigational device, that uses the polarisation of the skylight as input signal. Such a navigation device is an alternative method for navigation, independent of GPS. The presentation will give a survey of biological principles regarding navigation systems based on polarised skylight. The presenter is a biologist who has over the last year acquired experience in talking to engineers, discussing biomimetic approaches.