BIOLOGY COLLOQUIUM

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Hosted by A/P Antonia Monteiro

Stomatopod crustaceans: optical data storage, cancer detection and satellite design through natures nanostructures

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Stomatopods love light. These sometimes shy, sometimes violent shrimps detect more of the spectrum than any other animal and also manipulate light through pigments, molecules, optical elements and cuticular nanostructures in ways that have biologists reaching for physics text books. As well as their neatly spaced twelve spectral sensitivities (20nm half band-width with peaks from 315-710nm) several species also sample polarised light comprehensively with receptors arrayed at 0,45,90,135o and with both left and right handed circular polarisation receptors.

Instead of a desire (through evolution) to construct a dodecahedral colour space or a Poincaré sphere to fully describe light, we hypothesise that mantis shrimps are more interested in the examination of signals and surfaces, particularly those from their own bodies.

This presentation will both summarise our present knowledge of stomatopod vision, suggesting some reasons for the evolution of their remarkably different visual system, and will also describe some of the coloured and polarised light reflection elements that stomatopods apparently use to 'talk' to each other. Structural reflections mechanisms, including scatter and selective e-vector reflection and transmission, as well as pigmentary mechanisms are used for this language.

Other uses of colour and polarisation, such as foraging, food quality selection, navigation and dehazing water may also drive the evolution of this remarkable visual system. The need to solve some of these object detection problems in our (human) world has led to three bio-inspired spin-off directions from our research in stomatopod vision: early cancer detection, optical data storage for computing and satellite design. Results from these applications will be presented, particularly those using the stomatopod-eye inspired underwater polarisation camera that we are using to cut-through-the-crap.

Artwork by Ann Nee, DBS, NUS