The multiscale fluid mechanics of olfaction in insects: Particle Image Velocimetry (PIV) around 3D-printed models of antennae

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Abstract

Volatiles perception by insects is a multiscale phenomenon. We present here our first results on the dynamics of flow around a multiscale antenna of a moth, *Samia Cynthia* (Saturniidae). Because of the multiscale aspects of these antennas, which span four orders of magnitude (from the 3-μm diameter of the sensillae to the 1-cm length of the whole antenna), no single additive technology able to print a whole antenna. Thus, we built two 3D physical models of different architectures, focusing either on the scale made of the main branch and the secondary branches (called ramis), and on the scale made of the ramis and the hair-like sensillae (see picture). For the same reasons as above, the overall antenna and the sensillae on it are living in very different Reynolds numbers (from 0.001 to almost 1000) for a single air flow so we decided to use Particle Image Velocimetry, both in water and oil, at different speeds to understand the structure of the flow around the antenna. From these flow profiles, we calculated the proportion of volatiles reaching the antenna and derived the efficiency of the antenna in terms of molecule capture.

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