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Several winged insects, such as bees, oscillate up and down while flying forward or wobble around hover. These oscillatory movement generate respectively an expansion and contraction component as well as rotational component in their ventral optic flow vector field. Using this optic flow vector field and a motion model, (i) the current ground height [1] and (ii) pitch & roll [2] can be estimated in most cases on flying robots. The ground height estimate can then be used to scale the mathematical integration of the translational optic flow and thus to gauge the distance travelled. [1] In the case of hovering still [2], the presence of unobservable states leads to slight attitude oscillations, reminiscent of insect wobble.

[1] L. Bergantin et al., J R Soc Interface, 2021

[2] de Croon et al., Nature, 2022