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Two- and three-dimensional numerical simulations of clap-fling-sweep of hovering insects MARIE FARGE, LMD-CNRS, Ecole Normale Superieure, Paris, France, DMITRY KOLOMENSKIY, M2P2-CNRS & Aix-Marseille University, France, KEITH MOFFATT, DAMTP, University of Cambridge, U.K., KAI SCHNEIDER, M2P2-CNRS & CMI Aix-Marseille University, France — The Lighthill–Weis-Fogh clap-fling-sweep mechanism is a movement used by some insects to improve their flight performance. As first suggested by Lighthill (JFM, 1973), this mechanism allows large circulations around the wings to be established immediately as they start to move. Initially, the wings are clapped. Then they fling open like a book, and a non-zero circulation is established around each of them. Thus one wing can be considered as the starting vortex for the other. Then they sweep apart, carrying these bound vortices and generating lift. Since the insect wings have relatively low aspect ratio and rotate, three-dimensional effects are important, such as spanwise flow and stabilization of the leading edge vortices (Maxworthy, JFM 2007). To explore these effects, we perform direct numerical simulations of flapping wings, using a pseudo-spectral method with volume penalization. Comparing two- and three-dimensional simulations for the same setup clarifies the role of the three-dimensionality of the wake. Our results show that the two-dimensional approximation describes very well the flow during fling, when the wings are near, but three-dimensional effects become crucial when the wings move far apart.

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