Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Adaptive numerical simulations of insect flight to study the impact of wing damage[1] THOMAS ENGELS, HENJA WEHMANN, FRITZ LEHMANN, Institute of Biosciences, Animal Physiology, Rostock University, Germany, KAI SCHNEIDER, Institut de Mathématiques de Marseille (I2M), Aix-Marseille Université, CNRS and Centrale Marseille, France — A wavelet-based adaptive approach to compute the aerodynamics of flapping insects is presented. Dynamically evolving grids using regular Cartesian blocks allow significant reduction of memory and CPU time requirements while monitoring the precision of the computation. Distributing the blocks among MPI processes permits an efficient parallelization on large scale supercomputers. The numerical approximation uses artificial compressibility to avoid solving elliptic problems and volume penalization is applied to impose boundary conditions on the Cartesian grids. A centered 4th order finite difference discretization is combined with biorthogonal interpolating wavelets as grid refinement indicators. Validation cases are presented to assess the accuracy and performance of the open access code WABBIT on massively parallel computer architectures (arXiv:1912.05371). Computations using realistic fly bodies obtained from mirco-CT scans are presented and the impact of wing damage in flapping flight is investigated.

[1]The authors acknowledge HPC resources of IDRIS (No. 2020-91664) by TGCC-GENCI (A0082A01664).

Kai Schneider
Institut de Mathématiques de Marseille (I2M), Aix-Marseille Université, CNRS and Centrale Marseille, France

Date submitted: 31 Jul 2020 Electronic form version 1.4