Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Direct numerical simulations of aerofoil noise due to flow separation and stall[1] JACOB TURNER, JAE WOOK KIM, Univ of Southampton — Aerofoil flow separation and stall is a significant source of self-noise for many engineering applications, particularly when operating at high angles of attack in unsteady inflow condition. Despite this, the noise generation mechanisms for stalled flows remains relatively unexplored. The aim of this work is to provide an improved understanding of both the dipole and quadrupole noise sources utilising direct numerical simulations. A NACA0012 aerofoil with a large spanwise domain size (one chord length) is considered for a Reynolds number of 50,000 and Mach number of 0.4. The far-field sound is calculated with a Ffowcs Williams and Hawkings solver at three angles of attack (α): pre-stall ($\alpha = 5°$), near-stall (10°), and full-stall (15°). The radiated noise is significantly increased at low frequencies for the full-stall case. It is found that the full-stall case produces a more in-phase source distribution at most frequencies, resulting in more efficient radiation. The frequency filtered flow field is used to identify the flow structures responsible for the noise generation. At low frequency coherent vortices appearing in the separated shear layer dominate, while at high frequency vortices shed from the trailing-edge play a prominent role.

[1]EPSRC EP/R010900/1

Jacob Turner
Univ of Southampton

Date submitted: 03 Aug 2020 Electronic form version 1.4