Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

An iterative methodology for the computation of perturbation fields induced by harmonic forcing of the linearised Navier-Stokes equations in complex geometries and application to forced cylinder wakes[1]

GEORGE PAPADAKIS, LIANG LU, Imperial College London — An efficient, iterative methodology is developed for the computation of the perturbation fields induced by harmonic forcing of the linearised Navier-Stokes equations in complex geometries. The problem is formulated in the frequency domain and the resulting system of equations is solved iteratively until convergence. This approach offers distinct advantages: convergence is monitored easily, and the solution from one value of frequency can be used as a restart field for another, nearby, frequency. It is also straightforward to implement in any implicit code that solves the steady Navier-Stokes equations iteratively. The method can be extended to solve the optimal forcing problem, i.e. to find the forcing fields that will maximise the energy of the flow perturbations for a particular frequency. In the present study, the method is applied to investigate the wake behind a cylinder with pulsating approaching flow. The perturbation velocity and pressure fields induced by external forcing are computed and the mechanisms that drive the energy growth of the developed structures in the wake are examined. It is shown that perturbations grow by extracting energy from two sources: the underlying base flow field and the externally provided energy that maintains the imposed oscillation.

[1]Part of this work was supported by EPSRC EP/I016015/1

George Papadakis
Imperial College London

Date submitted: 25 Jul 2013 Electronic form version 1.4