Compiled Data on wake transition of flapping foils for various harmonic combinations

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1. Overview

The dataset within this file was used to form the figures 3, 4, 5, and 6 of the JFM-Rapids’ paper*: Universal scaling law for drag-to-thrust wake transition in flapping foils.* This data is derived from numerical simulations conducted by a BDIM 2D solver *(Lotus)* via the *Iridis Compute Cluster* of the University of Southampton. The data is grouped according to the corresponding figure in separate sheets of the excel file *JFM\_Data.xlsx*. In the following paragraphs, specific guidance is given to the reader with respect to each figure separately.

2. Data of Figure 3

No separate sheet exists for figure 3 as (a) there is a sufficient detailed description below the figure and (b) the reader can make use of the data set of figure 4 and 5 to verify the findings of figure 3.

3. Data of Figure 4

Data for this figure can be found in sheet *Figure4Set.* Ct or Uwake is not given for this set as we focus on the qualitative characterisation of the wakes for the Sr-Ad combinations tested. The three main categories are the classic Benard von Karman wake, the reversed Benard von Karman wake and the asymmetric wake. Thus, the various Sr-AD points are noted as: BvKwake, rev. BvKwake or Deflected wake. The dashed curves that correspond to the neutral lines are the best fit curves of the broad zone between the BvK and the reversed BvK wake and thus their equations can be found in *Figure5Set*.

4. Data of Figure 5

The equations of the neutral line best fit curves for all kinematics tested at Re=1173 are given in the sheet *Figure5Set*. As the neutral line is a highly unsteady wake and can be obtained within a narrow range rather than a specific curve we present here the best fit curves of a Uwake ~ 1.04\*Ufree stream which corresponds to roughly the earliest reversed BvK wake just after the neutral line.

More specifically we present the equations of these curves for both the AD-Sr and the *T*D-Sr chart. All cases of AD(Sr) can be presented as a power law (depended on the kinematics) except of Coupled motion for P=0, alpha=20 degrees where the equation is an exponential. On the other hand all *T*D(Sr) curves are expressed as a power law which converges into *T*D(Sr) ~ 1.03\* Sr ^ (-1)

5. Data of Figure 6

The data of this figure can be found in *Figure6Set*. Here we present step-by-step the formation of the y-axis of each of the 4 subfigures. For example to measure the non dimensional square wake length you need to add: 2\* A + 2\* Period\*Ufree stream + 2\* A so that a rectangle is formed per cycle. Then you need to normalise the result with D=0.16 C which corresponds to the thickness of the foil. The Tr/D and Tau/D is calculated based on the equations (2.1) and (2.2) of the paper. Finally the wake over free stream velocity ratio is given for all cases. Once again this region corresponds to the early reversed BvK wakes at 4% velocity surplus just after the foil has transitioned from the neutral line.