Appendix A

Database available

A selection of the most relevant data produced for this thesis has been made available for public access at http://dx.doi.org/10.5258/SOTON/397076. The database consist of a number of plain text files containing the mean deflection and pressure and skin friction coefficient corresponding to the cases pressed in chapter 4, as well as a set of binary files containing instantaneous and averaged flow DNS data.

A.1 Data structure

A.1.1 Mean w, C_p and C_f files

The `.tar` files named `mean_w.tar` contains a series of text files `mean_w_$case.dat`, where the variable $case changes for each cases according to the case names in table 4.1. The same structure applies to `mean_Cf.tar` and `mean_Cp.tar`.

Each `mean_w_$case.dat` contains the deflection of the membrane at each position along the chord with respect to its original position, averaged in time. The data is stored in two columns, the first column contains the locations along the chord and the second columns is the averaged deflection, with a first line of text indicating the corresponding variable and case parameters.

Each `mean_Cp_$case.dat` contains the lower and upper surface pressure coefficient at each position along the chord. The data is stored in two columns, the first column contains the locations along the chord and the second columns is the averaged C_p. The first half of the data correspond to lower surface of the aerofoil and the second half to the upper surface. The data of both surfaces is separated by a line of text indicating the corresponding variable and case parameters.

The structure of the `mean_Cf_$case.dat` containing the data corresponding to the skin friction coefficient is identical to the `mean_Cp_$case.dat` files.

A.1.2 Flow instantaneous data files

The `flow_field.tar` file contains a file `Subsaces_$time1_$time2.tar` that comprises a set of binaries files, `acoustic_1_var_5_$time.raw`, enclosing instantaneous flow field data from time step $time1 to $time2. The flow quantities stored in each file `acoustic_1_var_5_$time.raw` are `data`$[\rho, u_1, u_2, u_3, p, \nabla\cdot\vec{u}]$. Additionally a file `acoustic_GRID_1.xyz` contains the grid coordinates `grid`$[x, y, z]$. The file structure is given in tables A.1 and A.2.

A.1.3 Flow statistics data files

The `flow_field.tar` file also contains a file `STAT_cont_$time1_$time2.bin` that encloses time averaged flow field data from time step $time1 to $time2. The flow quantities stored in this file are `data`$\left[x, y, z, \overline{\rho}, \widetilde{u_1}, \widetilde{u_2}, \widetilde{T}, \overline{p}, \frac{\overline{\mu}}{\mathrm{Re}_\infty}, \sqrt{\overline{\rho'^2}}, \sqrt{\widetilde{T'^2}}, \sqrt{\overline{p'^2}}, \tau_{11}, \tau_{12}, \tau_{22}\right]$

Table A.1: Data structure of the `acoustic_GRID_1.xyz` files.

Bits	Data type	Quantity
32	integer	N_X
32	integer	N_Y
32	integer	N_Z
32	float	grid$[nvar, i, j, k]$
		for $nvar = 1, 3$:
		for $k = 1, N_Z$:
		for $j = 1, N_Y$:
		for $i = 1, N_X$:
		grid$[nvar, i, j, k]$

Table A.2: Data structure of the `acoustic_1_var_5_$time.raw` files.

Bits	Data type	Quantity
32	integer	N_X
32	integer	N_Y
32	integer	N_Z
32	float	Mach
32	float	0
32	float	Reynolds
32	float	time
32	float	data$[nvar, i, j, k]$
		for $nvar = 1, 6$:
		for $k = 1, N_Z$:
		for $j = 1, N_Y$:
		for $i = 1, N_X$:
		data$[nvar, i, j, k]$

Table A.3: Data structure of the `STAT_cont_$time1_$time2.bin` files.

Bits	Data type	Quantity
32	integer	0
32	integer	1
32	integer	1
32	integer	1
32	integer	N_X
32	integer	N_Y
32	integer	N_Z
32	integer	2
32	integer	100
32	integer	3
32	integer	101
32	integer	12 (16)
32	integer	numbers of samples
32	integer	start time step
32	integer	end time step
32	float	time interval
32	float	data$[nvar, i, j]$
		for $nvar = 1, 15$:
		for $k = 1, N_Y$:
		for $j = 1, N_X$:
		data$[nvar, i, j]$

for the two-dimensional cases and additionally $\tau_{33}, \tau_{13}, \tau_{23}, \widetilde{u_3}$ for the three-dimensional cases. The file structure is given in table A.3.