

SESA3033 Wing Aerodynamics Coursework

This coursework contributes 20% to the final mark. The deadline is **7th May 2024 (Tuesday)**. Coursework should be submitted via Blackboard.

1. Use the Matlab or Python codes provided on Bb under 'Assignment/CW' and the parameter given in Table 1 to generate your own Karman-Trefftz (KT) aerofoil and analyze the aerofoil geometric parameters.
 - a) Find the closest NACA 4-digit aerofoil to your KT aerofoil, by calculating the maximum camber and its position, and the maximum thickness of your KT aerofoil. Plot the aerofoils on the same graph to demonstrate differences. To better compare with NACA aerofoil, use the definition that the aerofoil thickness is the distance between the two surfaces **normal to** the camber line. (10%)
 - b) Varying ϵ , then β separately (e.g. over a range 0~0.1), with the other two parameters fixed to the given values for your aerofoil and find out how the maximum thickness and maximum camber of your KT aerofoil vary with the corresponding parameter. (10%)
2. Analyze the aerodynamic performance using doublet panel method, with the provided code (dpan) on Bb under 'Assignment/CW'.
 - a) with different number of panels for your KT aerofoil at 3 degrees of incidence, and find out the order of accuracy of the doublet panel method by compare the C_L results from the panel method with the theoretical value from conformal mapping. (15%)
 - b) Run the doublet panel method code with a different panel distribution and panel numbers, this can be achieved by changing θ distribution and number of points on the cylinder surface, analyze how the panel distribution influences the panel method accuracy. (15%)
3. Run inviscid calculations using both the doublet panel code and Xfoil over a range of angle of attack (e.g. $AoA = -5^\circ \sim 15^\circ$), compare the results from the two methods, and the performance of the two aerofoils. (10%)
4. Use Xfoil to perform incompressible simulations for the two aerofoils at $Re = 10^5$ and $5 \cdot 10^6$ at different AoAs (e.g. from -5 degrees to post-stall). Analyze the flow and compare the performance of the aerofoils (BL thicknesses, shape factor, skin friction, separate and transition). Compare the results obtained at different Reynolds numbers, discuss the influence of Reynolds number on aerofoil performance (40%)

Write a report (No more than 6 A4 pages) to include an executive summary (100~150 words) for non-technical readers, followed by technical analysis and discussion of the results.

Zhiwei Hu 15th Feb 2024

Table 1: Parameters for your Karman-Trefftz aerofoil

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Parameter			ϵ	β	τ
1	., Wazil Nizar	35473215	0.07	0.02	0.1
2	Anderson, Beth	32909357	0.07	0.02	0.15
3	Bakare, Emmanuel O.	30728274	0.07	0.02	0.2
4	Beh, Radley	33295514	0.07	0.03	0.1
5	Booy, David A.	31586775	0.07	0.03	0.15
6	Boudville, Nicholas P.	33036276	0.07	0.03	0.2
7	Bramantasaputra, Zefanya	35423676	0.07	0.04	0.1
8	Butel, Sophie E.	31941133	0.07	0.04	0.15
9	Carter, Elainor	33003653	0.07	0.04	0.2
10	Cepic, Luka	35433582	0.07	0.05	0.1
11	Chan, Xiang Yu	32248776	0.07	0.05	0.15
12	Chaumier, Lubin	35754095	0.07	0.05	0.2
13	Chenna Keshava, Priyamvada	34793364	0.07	0.06	0.1
14	Chow, Weng Yan	33296138	0.07	0.06	0.15
15	Chua, Hoe-Teng	33245622	0.07	0.06	0.2
16	Crawford, Owen	31693148	0.07	0.07	0.1
17	Crewe, Richard P.	32675577	0.07	0.07	0.15
18	Davies, Henry D.	32560117	0.07	0.07	0.2
19	De La Vega Villate, Jose	32110197	0.07	0.08	0.1
20	Ericksson, Tim	33139636	0.07	0.08	0.15
21	Evans, Joel M.	32801831	0.07	0.08	0.2
22	Fitzgerald, Jack J.	32916116	0.08	0.02	0.1
23	Fry, Tristan	35216425	0.08	0.02	0.15
24	Griffiths, Emily L.	32950748	0.08	0.02	0.2
25	Harris, Alexander D.	32737343	0.08	0.03	0.1
26	Haywood, Oscar R.	32631715	0.08	0.03	0.15
27	He, Zhaogji	34791396	0.08	0.03	0.2
28	Honey, Samuel J.	32906641	0.08	0.04	0.1
29	Huang, Chi-Wei	35251905	0.08	0.04	0.15
30	Hussain, Enayaat D.	31648975	0.08	0.04	0.2
31	lu, Weng L.	32557183	0.08	0.05	0.1
32	Izzadeen, Haaziq	32079303	0.08	0.05	0.15
33	Jardinez Arriaga, Pablo Angel	34612238	0.08	0.05	0.2
34	Jovanovic, Marko	35432543	0.08	0.06	0.1
35	Ko-Ferrigno, Natalie S.	32748361	0.08	0.06	0.15
36	Kobori, Takatoshi	35215259	0.08	0.06	0.2
37	Krossa, Dradon	35411058	0.08	0.07	0.1
38	Kuek, Cheng Yuan	31487319	0.08	0.07	0.15
39	Lai, Weldon W.	31541844	0.08	0.07	0.2
40	Lau, Jacqi	33295964	0.08	0.08	0.1

41	Lee, Ji K.	32391447	0.08	0.08	0.15
42	Lee, Wei Qin	33352887	0.08	0.08	0.2
43	Lyons, Anthony	30646774	0.09	0.02	0.1
44	Madams, Daniel P.	32548079	0.09	0.02	0.15
45	Makhija, Jai	35113871	0.09	0.02	0.2
46	Mapara, Tiana V.	32132611	0.09	0.03	0.1
47	Mayne, Benjamin	32801769	0.09	0.03	0.15
48	Menon, Devika A.	33040109	0.09	0.03	0.2
49	Merritt, Oliver M.	32958935	0.09	0.04	0.1
50	Mohamed Ahmed, Bilal	34396713	0.09	0.04	0.15
51	Mosora, Andrei	32984502	0.09	0.04	0.2
52	Ng, Jing Hong	32249071	0.09	0.05	0.1
53	Nhamo, Tawana T.	32996217	0.09	0.05	0.15
54	Ni, Mingxuan	35166754	0.09	0.05	0.2
55	Nummy-Taggart, David	32635508	0.09	0.06	0.1
56	Oftebro, Connor N.	33035164	0.09	0.06	0.15
57	Orchard, Finn J.	31628419	0.09	0.06	0.2
58	Orpin, Danny F.	32814267	0.09	0.07	0.1
59	Ozenfant, Lucie	35799684	0.09	0.07	0.15
60	Pang, Aaron	32976615	0.09	0.07	0.2
61	Patel, Milan	32980043	0.09	0.08	0.1
62	Perez Torres, Edgar Ossiel	34664076	0.09	0.08	0.15
63	Pinto, Martin P.	32544812	0.09	0.08	0.2
64	Rennie, James D.	32074921	0.06	0.02	0.1
65	Reynolds, Daniel G.	32963262	0.06	0.02	0.15
66	Seymour, Joseph H.	33134154	0.06	0.02	0.2
67	Sheikh, Mohammad Y.	32608918	0.06	0.03	0.1
68	Shum, Benjamin	32954905	0.06	0.03	0.15
69	Soong, Mingxuan	32394586	0.06	0.03	0.2
70	Srinivasan, Dhanushkumar	35144297	0.06	0.04	0.1
71	Surci, Giacomo	33134294	0.06	0.04	0.15
72	Tan, Jie I.	32492456	0.06	0.04	0.2
73	Temple, William	32628056	0.06	0.05	0.1
74	Teo, Jun Y.	33177732	0.06	0.05	0.15
75	Trpik, Carson M.	34347453	0.06	0.05	0.2
76	Truscott, Thomas	35048441	0.06	0.06	0.1
77	Turney, Max	35398493	0.06	0.06	0.15
78	Underwood, Ethan	32822553	0.06	0.06	0.2
79	Valdavičius, Daniel M.	32076061	0.06	0.07	0.1
80	Vincent, Alfred J.	32690312	0.06	0.07	0.15
81	Wangsadiredja, Mulyadi	34403418	0.06	0.07	0.2
82	Wickremabandu, Dineth	32919913	0.06	0.08	0.1

83	Williams, Charles P.	32564902	0.06	0.08	0.15
84	Wilson, Alexander	32620683	0.06	0.08	0.2
85	Woodford, Drew	34579141	0.05	0.02	0.1
86	Wu, Da-Shan	35158719	0.05	0.02	0.15
87	Yau, Tsz Yin	33389497	0.05	0.02	0.2
88	Yu, Marcus M.	31628141	0.05	0.03	0.1
89	Zhang, Daniel Y.	32221622	0.05	0.03	0.15
90	Zuzia, Filip P.	32985266	0.05	0.03	0.2
91			0.05	0.04	0.1
92			0.05	0.04	0.15
93			0.05	0.04	0.2
94			0.05	0.05	0.1
95			0.05	0.05	0.15
96			0.05	0.05	0.2
97			0.05	0.06	0.1
98			0.05	0.06	0.15

NACA 4-digit aerofoil generator: <http://airfoiltools.com/airfoil/naca4digit>

Matlab tutorial and help

https://uk.mathworks.com/support/learn-with-matlab-tutorials.html?s_tid=gn_loc_drop