1 Syllabus

- Lecturer: Dr.techn. Lukáš Bábor, MSc.
  - E-Mail: lukas.babor@tuwien.ac.at
  - Tel.: +43 1 58801 32214
  - Office: Getreidemarkt 9, Tower BA, 7th floor, room BA07G08
    Dial 32214 on the phone on the wall, next to the door.
    Consultations must be scheduled in advance, preferably by email.
  - Languages: English, basic German, Czech/Slovak
- Language of the course: English
- Programming language: MATLAB or Python
  Please, use a clean programming style and comment your codes.
- Attendance is required under standard terms:
  - 2 absences are allowed.
  - Absence must be announced by email before the session.
  - Additional absences can be compensated by home assignments for self-study
  - **Active** online participation is possible upon request in justified cases (illness etc.)
- Evaluation:
  - Home assignments
  - In-class assignments
  - Team project with a final report, to be completed by groups of 2 to 3 participants by the end of the semester. The tasks for the home assignment will be released in the middle of the semester.
- Communication:
  For questions or comments that might be of interest to others, please use the Discussion Forum in TUWEL.
- Literature:
  We will mostly follow the book of Moran (1984). For some topics, other references will be provided.

1.1 Prerequisites

- Interest in (fluid) mechanics and aerodynamics
- Basic programming experience in MATLAB or Python
- Mathematics
  - Linear algebra
    - Operations with matrices and vectors
    - Linear and nonlinear systems of equations, Gauss elimination
    - Eigenvalues and eigenvectors
  - Calculus
    - Ordinary and partial differential equations
    - Taylor expansion

    - Integrals
- Numerical methods
    - Newton-Raphson method
    - Numerical integration

1.2 Objective of the course

The objective of the course is to learn and practice analytical and numerical methods for efficient computation the flow over a body moving through a fluid and the forces acting on the body. We will start with the potential flow theory, considering flows over simple two-dimensional bodies for which analytical solutions of the external flow exist. Gradually, we will introduce numerical tools that will allow us to consider bodies of general shapes. The main focus is to compute the flow around airplane wings with minimal numerical effort.

1.3 Preliminary schedule

Lesson	Date	Topic
1	4.3.	Introduction, Types of Partial Differential Equations (PDEs), Solution of the wave equation using characteristics.
2	11.3.	Supersonic flow over a thin airfoil at zero lift, Governing equations for potential flows
3	18.3.	Subsonic flow over a thin airfoil at zero lift
4	24.3.	Computation of streamlines
5	1.4.	Incompressible potential flow over a thin lifting airfoil Potential flow theory, Kutta-Joukowski theorem
6	8.4.	Potential flows with circulation, Panel method
7	29.4.	Panel method
8	6.5.	Implementation of the panel method
9	13.5.	Revision
10	20.5.	Boundary layer theory
11	27.5.	Laminar boundary layer, integral methods
12	3.6.	Computation of turbulent boundary layer with integral methods
13	17.6.	Revision, Q & A
14	24.6.	Team project, Consultations

References

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