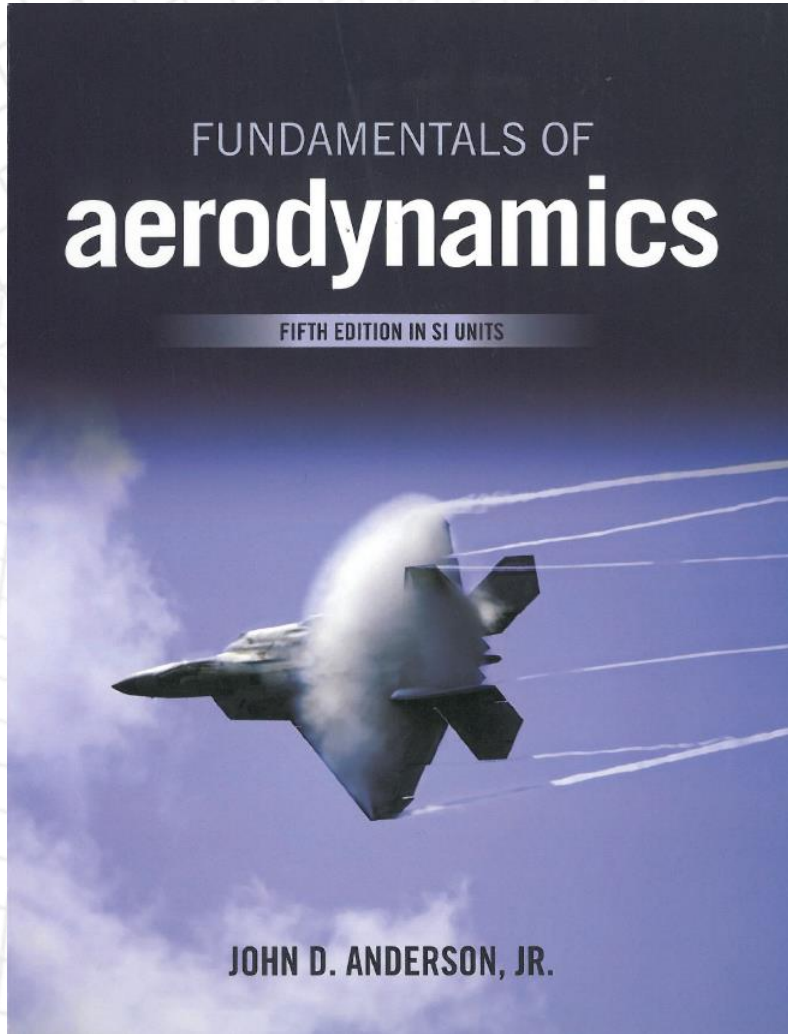


❖ Course Schedule for 'Aerodynamics' (Class 2017)

- Mon. & Weds. (11:00 ~ 12:15)
- Place: Bldg. 301 – Rm. 1303
- Professor : Soogab Lee (solee@snu.ac.kr)
- TA : Seoryong Park (tjfyd11@snu.ac.kr)
- Homepage : aancl.snu.ac.kr
- Text:
 - Class Note (download from [class homepage](#))
 - 'Fundamentals of Aerodynamics' by J.D. Anderson"

❖ Book



Aerodynamics 2017 fall

❖ Class Note

AANCL AeroAcoustics & Noise Control Laboratory | Seoul National University

ABOUT AANCL
RESEARCH
MEMBER
LECTURE
TEAMSITE

Quiet Environment for Human and Nature

Select Menu ▾ Course Introduction **Aerodynamics** Noise Engineering Helicopter Engineering

Advanced Aeroacoustics Design and Practice of Wind Turbine System

Aerodynamics

➤ 항공역학 (Aerodynamics)

▶ 수업에 필요한 각종 자료 및 과제를 합니다.

Lecture

제목 ▾ @ 검색

번호	제 목	작성자	작성날짜	파일
25	1주차 강의자료	박서룡	17-09-04	DOWN

Course Guideline (Y2017)

❖ Performance Evaluation

- Attendance & Participation : 10 % (extra)
- Homework & Projects : 40%
- Mid-term Quiz : 20% (if necessary)
- Final Exam.(Possibly a take-home): 40 %
- Random evaluation: 10% (ex: good answer in the class)
- Q&A: English/Korean

❖ Grades

- Late penalty on projects & exams
- if miss projects & exams => “F”

❖ **What to lecture...**

- Concepts, concepts, and concepts.....!!
- Mathematical Modeling
- Computational Programming
- Problem solving based on Physical Assessment

❖ Syllabus

W	Contents	W	Contents
1	Introduction to Aerodynamics Aerodynamic forces and moments	9	Kutta-Joukowski theorem
2	Aerodynamic forces and moments Center of pressure	10	Kutta condition Kelvin's circulation theorem
3	Similarity Dimensional analysis	11	Thin airfoil theory and Vortex panel method
4	Governing equations of aerodynamics	12	Modern high-lift airfoil
5	Substantial derivative	13	Downwash and Induced drag
6	Circulation, stream function, and velocity potential	14	Plandtl's lifting line theory
7	Bernoulli's equation, Conditions for irrotationality and incompressibility	15	Delta wing aerodynamics
8	Fundamentals of 2-D potential flows and source panel method	16	Final Exam

❖ **Introduction**

- Aerodynamics?
- Pictures about history of flight
- Application of Aerodynamics
 - Rocket/Airplane/Rotorcraft/Missile/Birds
 - HST/Train/Automobile/Hovercraft/Ship/Subways
 - Gas turbines/Compressor/Pump/Wind turbine/Propeller/
Fan (Rotating Machineries)
 - Pipe/Duct/Channel/Tunnel/HVAC/Combustor
 - Whatever it moves...

❖ **‘Aerodynamics’**

The term “Aerodynamics” is generally used for problems arising from flight and other topics involving the flow of air

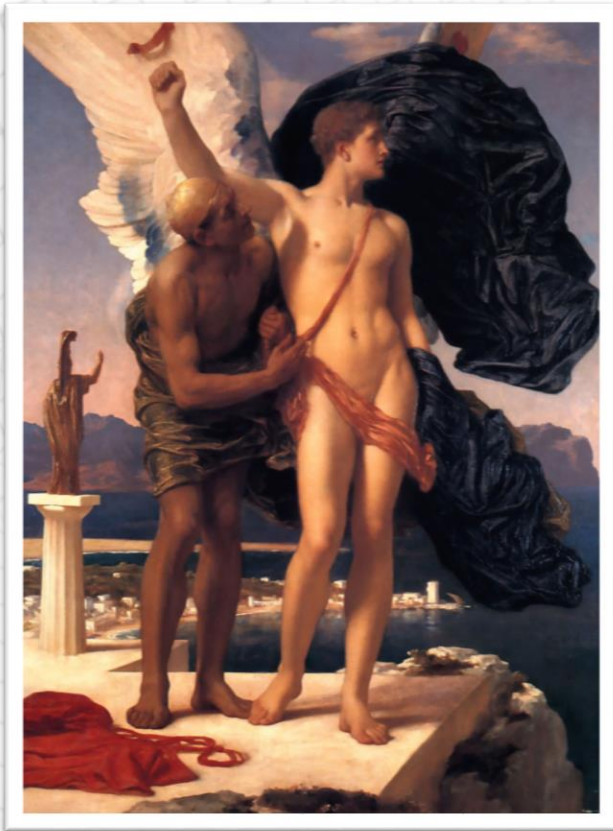
- Ludwig Prandtl, 1949

❖ Aerodynamics:

Aerodynamics : The dynamics of gases, especially atmospheric interactions with moving objects

- The American Heritage Dictionary of the Language, 1969**

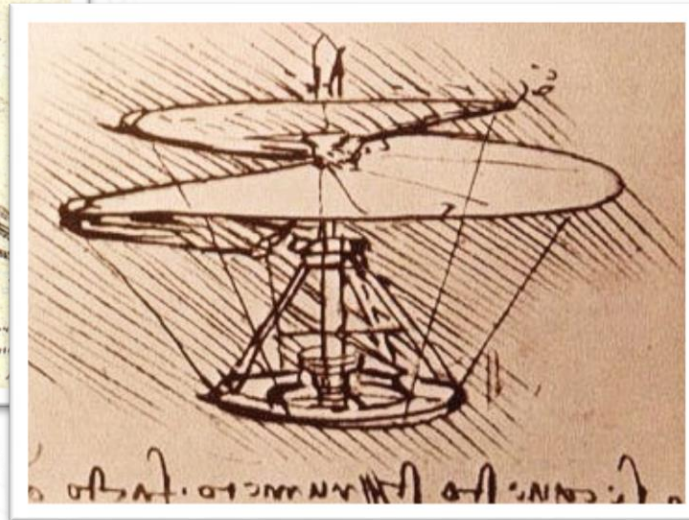
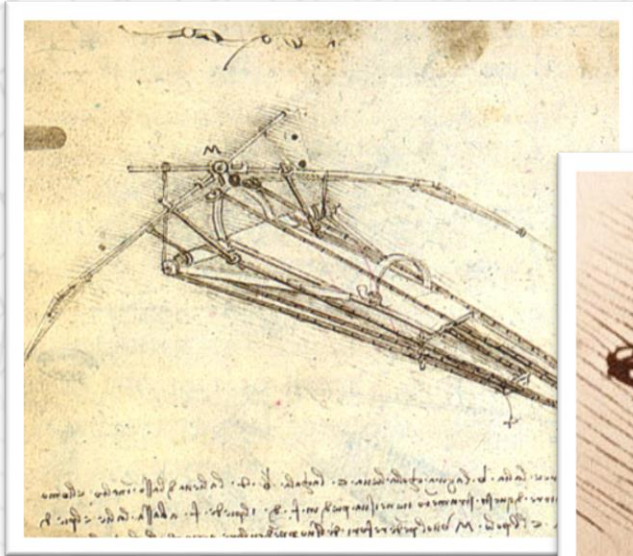
< Icarus and Daedalus > - 'Flight is just Myth'



'Icarus Paradox'

< Leonardo da Vinci 's Sketch (1452-1518)>

'Flight is creative concept'



< Montgolfier Brothers' Balloons > - “First Human Flight”

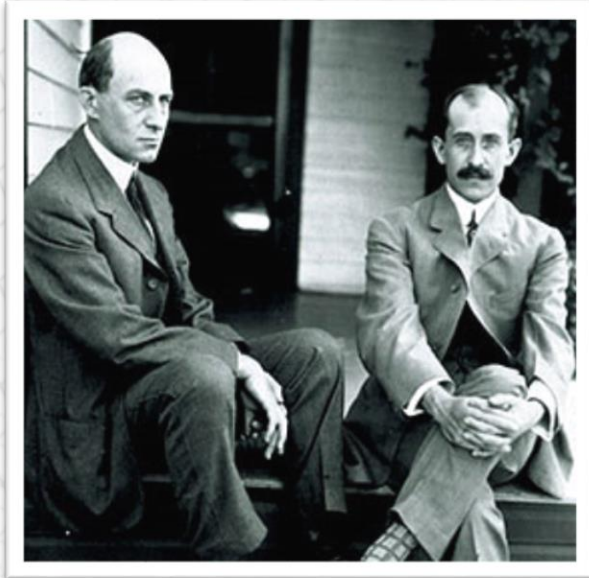
Joseph and Jacques Montgolfier, French paper-mill owners (1783)



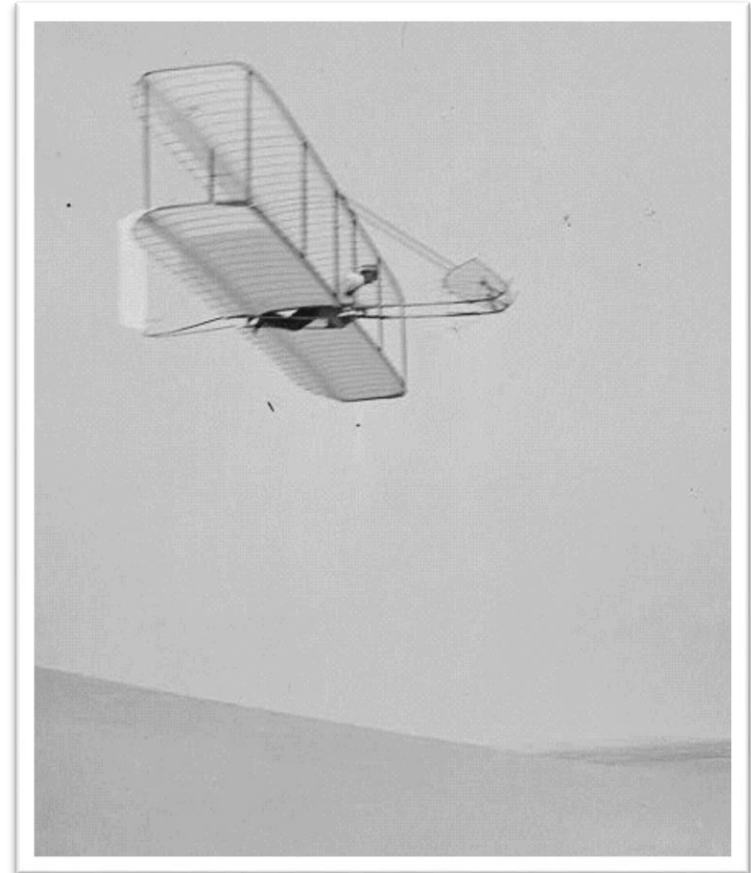
Paper-lined silk balloon



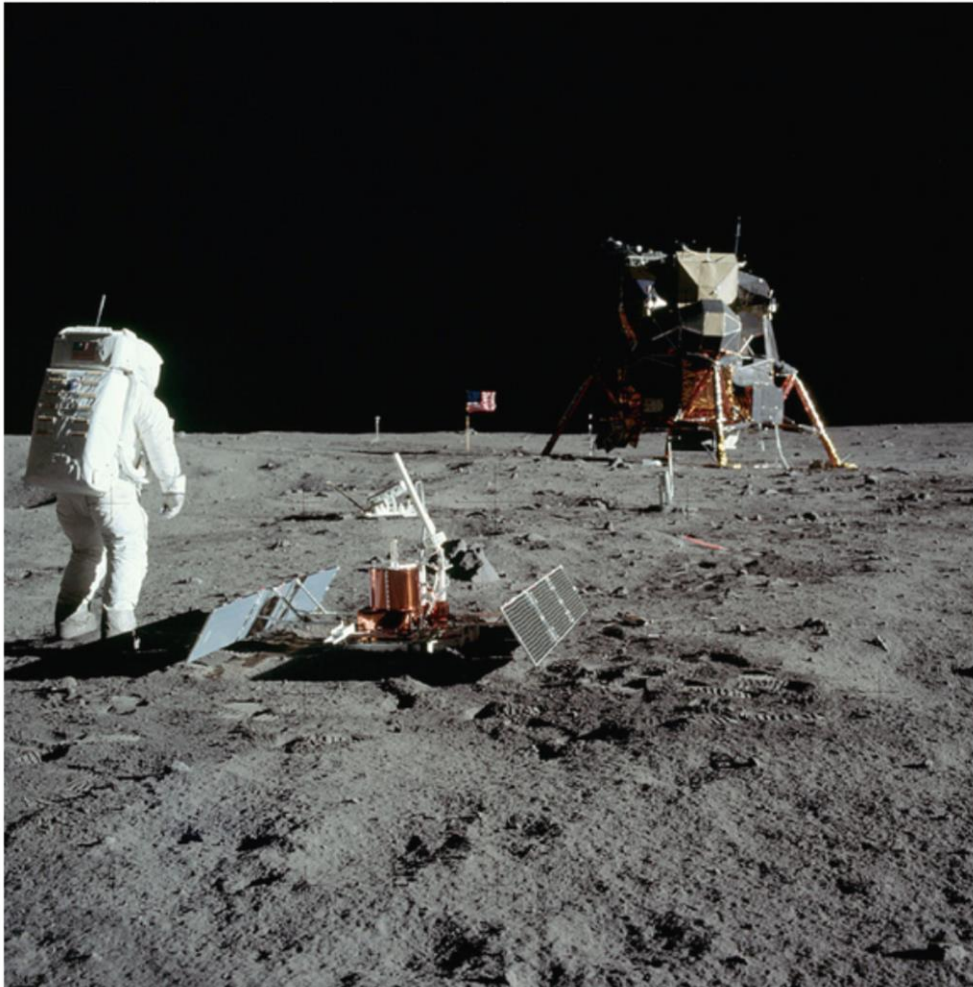
< Wilbur and Orville Wright >



“Wilbur Wright pilots the 1902 glider over the Kill-Devil Hills, Oct 10, 1902.”



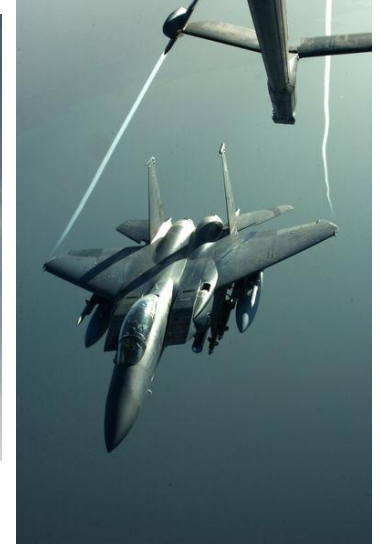
< Apollo 11 >



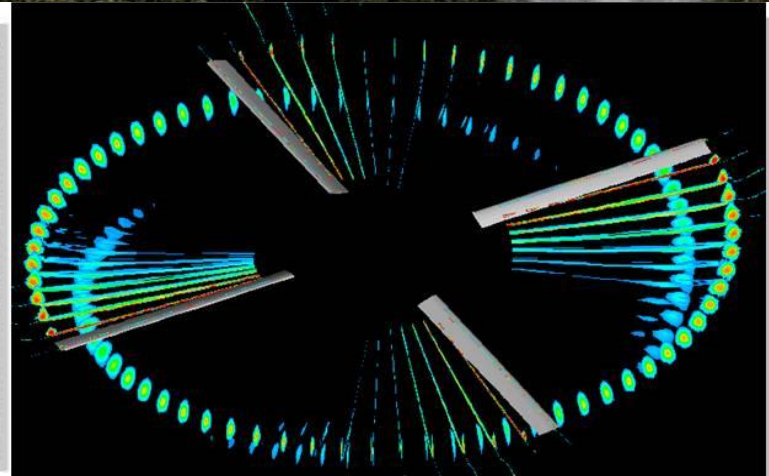
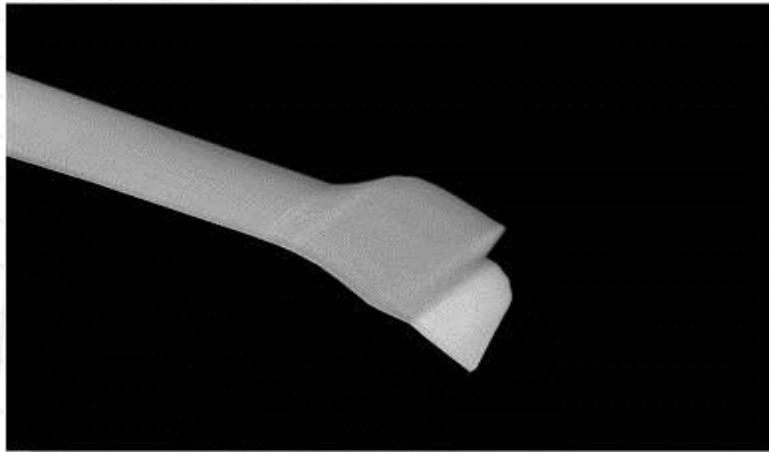
**“That's one small
step for (a) man,
one giant leap for
mankind.”**

**- Niel Armstrong
(1969)**

❖ Aerodynamics covers...



❖ Aerodynamics covers... < Rotorcraft >



❖ Aerodynamics covers... < Rotating machinery >



test18-K30f.avi

❖ **Aerodynamics covers... < Rotating machinery >**

- Totally new conceptual design for Automotive FAN
(Lowest noise in the world, higher performance)
- Currently used for Hyundai, Mercedes Benz, Ford etc.

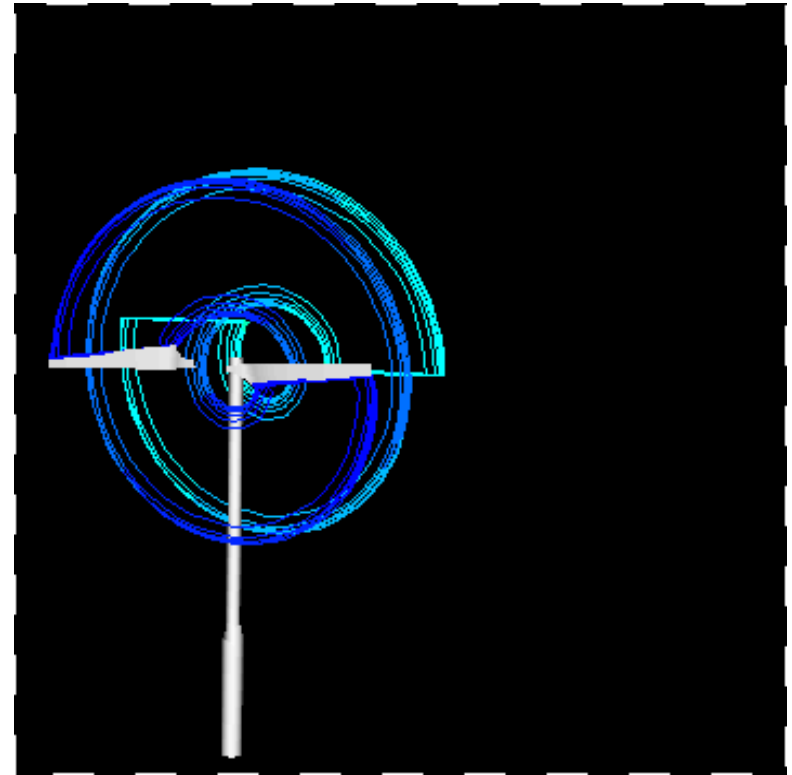


<Wave Fan, AANCL 2003 >

❖ Aerodynamics covers... < Wind Turbine Rotors >



<NREL Test Model>



<FVE Wake Analysis, 2005 AANCL>

< 1.2 Some Terminologies >

❖ “solid” – $\tau \propto \delta$

❖ “fluid” – liquid or gas

● Newtonian fluid : $\tau \propto \partial u / \partial y$

● Non-Newtonian fluid: $\tau \not\propto \partial u / \partial y$

❖ **Molecular level**

● Solid – almost “glued” by powerful intermolecular forces

● Liquid – fluidity

● Gas – weak intermolecular force

< 1.2 Some Terminologies >

❖ Classification of fluid dynamics

(study of the dynamics of both liquid and gases)

- Hydrodynamics - liquid
- Gas dynamics – gas (Air, N₂, He, ...)
- Aerodynamics - air
- External aerodynamics - the prediction of forces and moments of, and heat transfer to, bodies moving through a fluid
- Internal aerodynamics - Determination of flows moving internally through ducts

< 1.2 Some Terminologies >

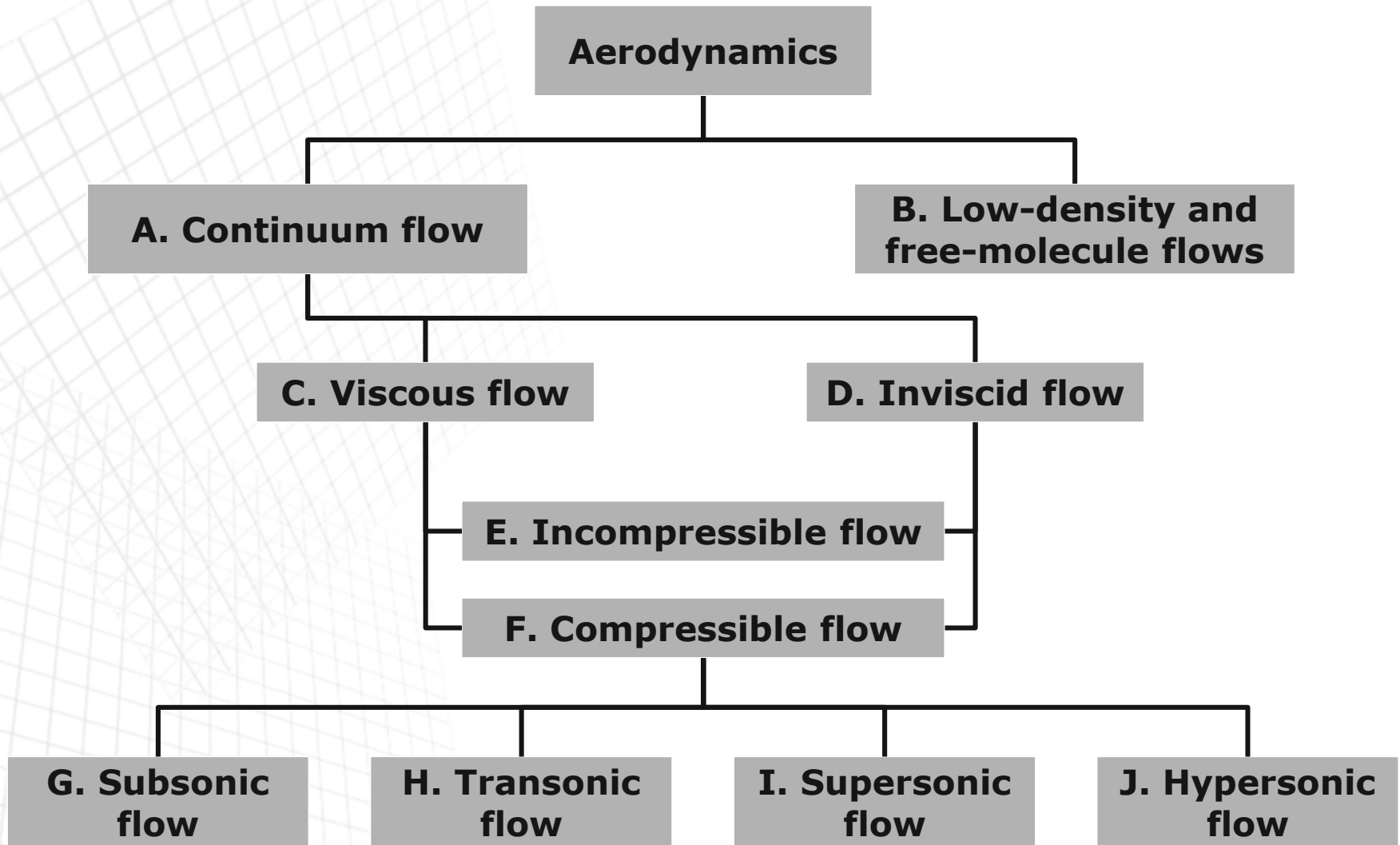
❖ Continuum flow

- Usual flow ($Kn \ll 1$)
- Rarefied gas dynamics ($Kn \gg 1$)

- Kn : Knudsen number = $\frac{\lambda}{L}$ \sim mean free length
 \sim characteristic length

- Newtonian fluid : $\tau \propto \partial u / \partial y$
- Non-Newtonian fluid : $\tau \not\propto \partial u / \partial y$

Introduction to Aerodynamics



< Block diagram categorizing the types of aerodynamic flows >