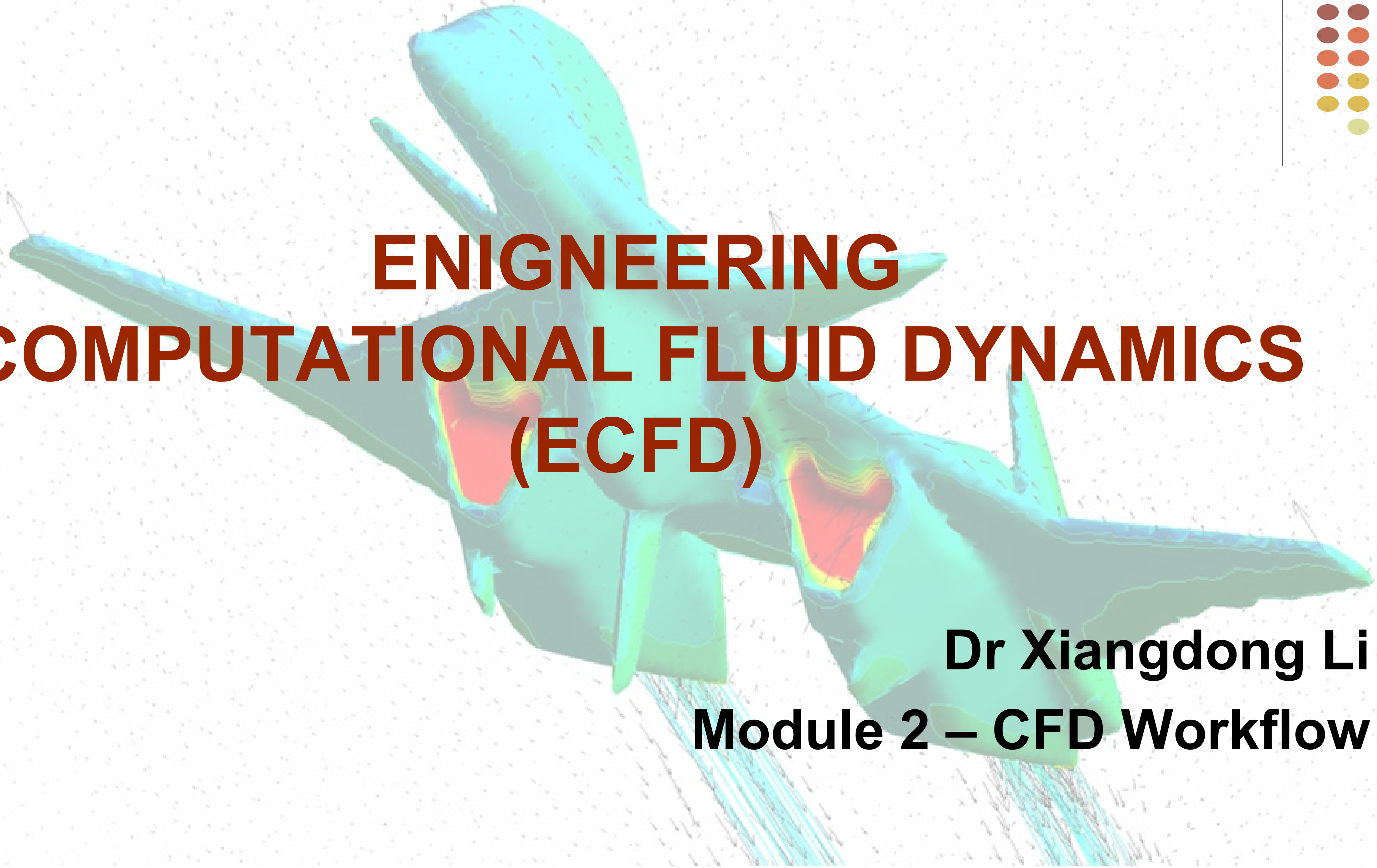


ENIGNEERING COMPUTATIONAL FLUID DYNAMICS (ECFD)

Dr Xiangdong Li

Module 2 – CFD Workflow

CFD workflow

Some people say

• Geometry • Mesh • Physics • Mathematical model	❖ Pre-processing
• Equation solution	❖ Solving
• Pesentation of results	❖ Post-processing

Geometry

SpaceClaim(Given)

Mesh

Fluent Meshing

Physics

With energy equation

Equation solutions

F-Cycle Linear solver
Second order scheme

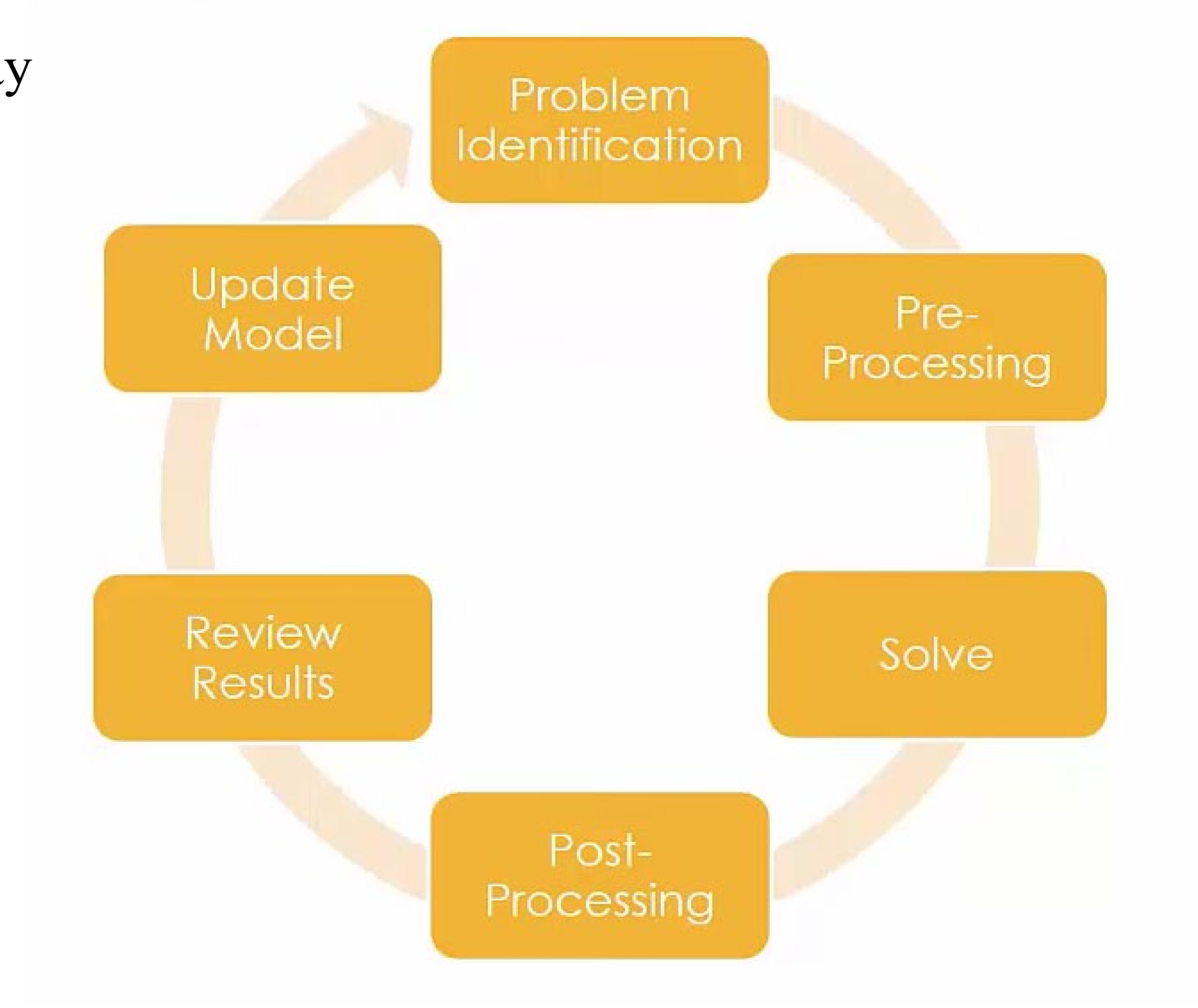
Presentation of results

CFD-Post

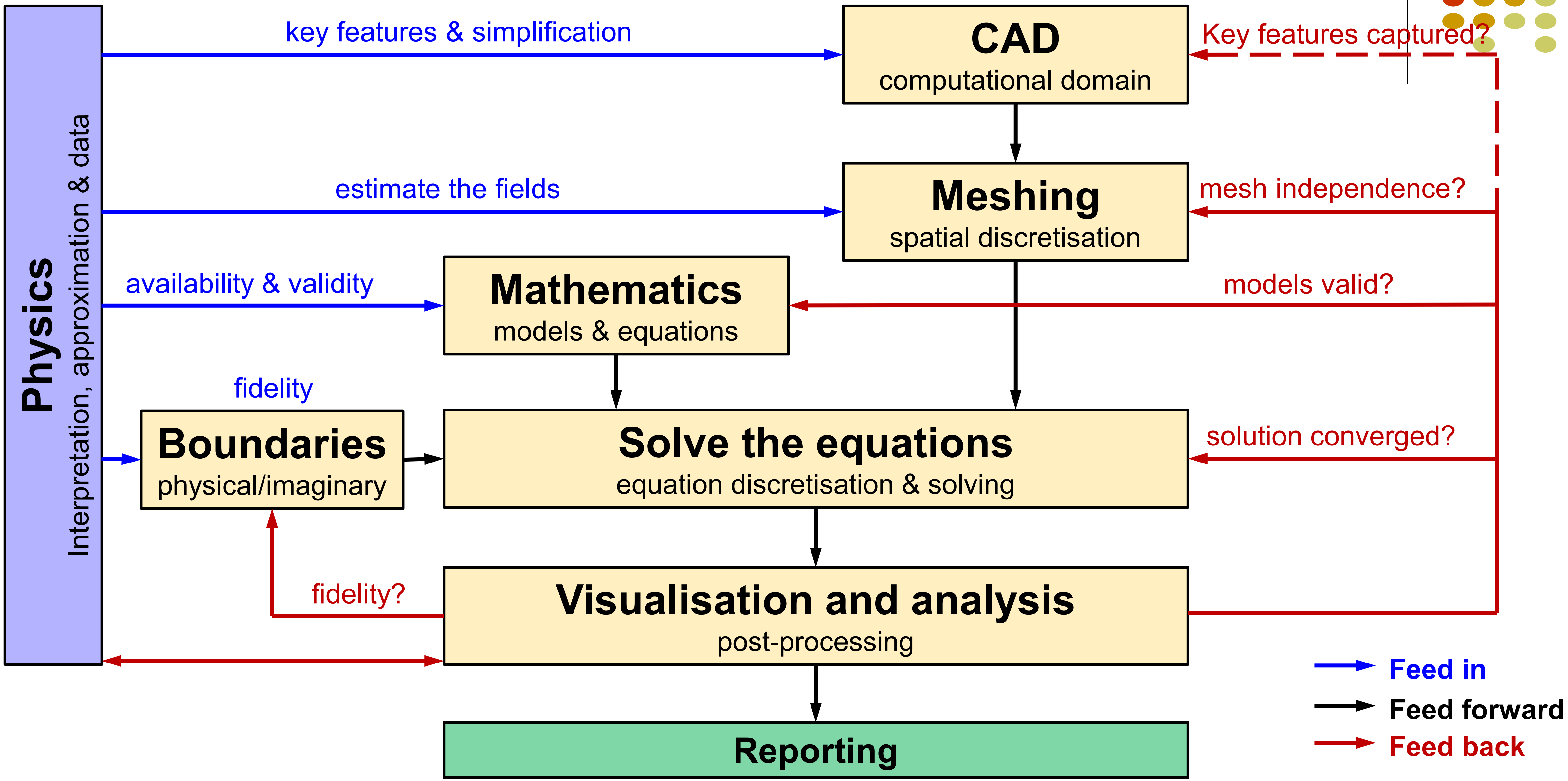
Tecplot

CFD workflow

More people say



CFD workflow



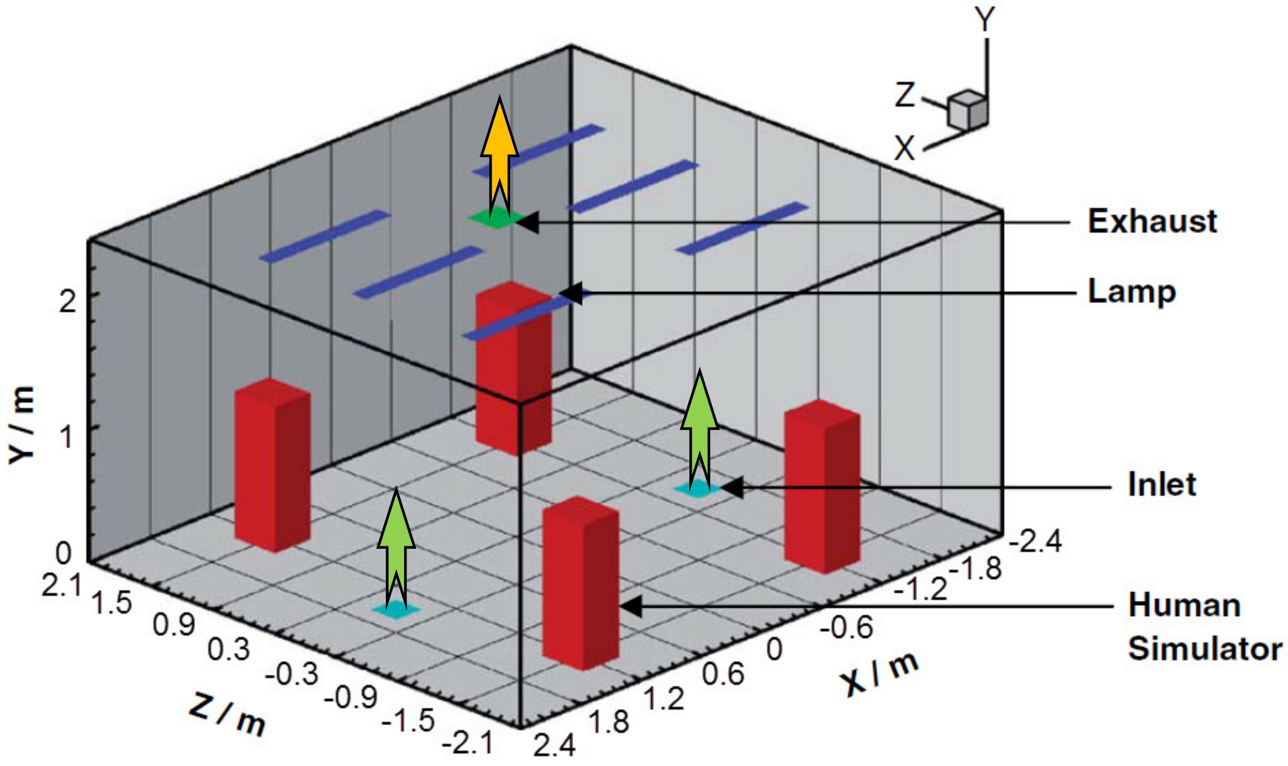
This module

- ❖ Sequential steps of a CFD simulation
- ❖ The basic operations with Ansys, including
  - Planning
  - SpaceClaim: Geometry
  - Fluent Meshing: domain discretisation
  - Fluent: Model setup and solver
  - CFD Post: Data visualisation and analysis
- ❖ **CAE workflow**

The computational case

https://www.simscale.com/docs/validation-cases/thermal-comfort-underfloor-air-distribution/

Element	X [m]	Y [m]	Z [m]
Room	4.8	4.2	2.4
Hum Sim	0.38	0.9	0.38
Inlets	0.25	–	0.25
Exhaust	0.25	–	0.25
Lamps	1.5	–	0.1



Material: Air

- *Viscosity model*: *Newtonian*
- (v) *Kinematic viscosity*: 1.5295e-5 m2/s
- (ρ) *Density*: 1.1965 kg/m3
- *Thermal expansion coefficient*: 0.00343 1K
- (T0) *Reference temperature*: 298.15 K
- *Specific heat*: 1004 Jkg.K

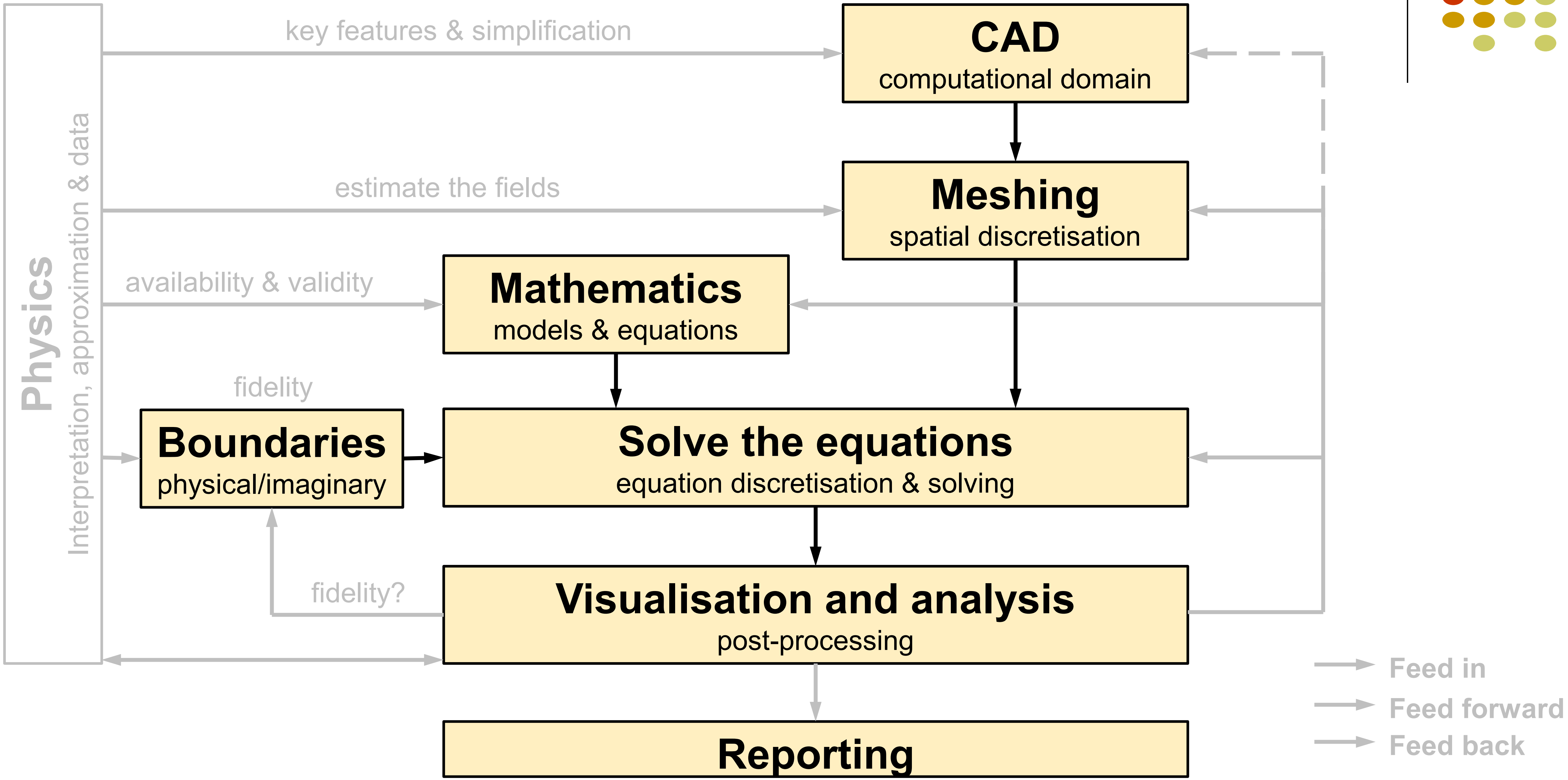
https://www.simscale.com/docs/validation-cases/thermal-comfort-underfloor-air-distribution/

The computational case

Element	Boundary Type	Boundary Condition Description
Inlet	Velocity inlet	0.0472 m3/s per inlet, at 293 K
Exhaust	Pressure outlet	Gauge pressure fixed at 0 Pa
Human simulators (top face)	Wall	No-slip condition with a turbulent heat flux. The power heat source is defined as 9.6 W per face.
Human simulators (side faces)	Wall	No-slip condition with a turbulent heat flux. The power heat source is defined as 22.6 W per face.
Lamps	Wall	No-slip condition with a turbulent heat flux. The power heat source is defined as 64 W per lamp.
Wall: positive x-direction	Wall	No-slip condition, with a fixed temperature of 297.7 K
Wall: negative x-direction	Wall	No-slip condition, with a fixed temperature of 298 K
Ceiling: positive y-direction	Wall	No-slip condition, with a fixed temperature of 298.7 K
Floor: negative y-direction	Wall	No-slip condition, with a fixed temperature of 297 K
Wall: positive z-direction	Wall	No-slip condition, with a fixed temperature of 298.5 K
Wall: negative z-direction	Wall	No-slip condition, with a fixed temperature of 298.3 K

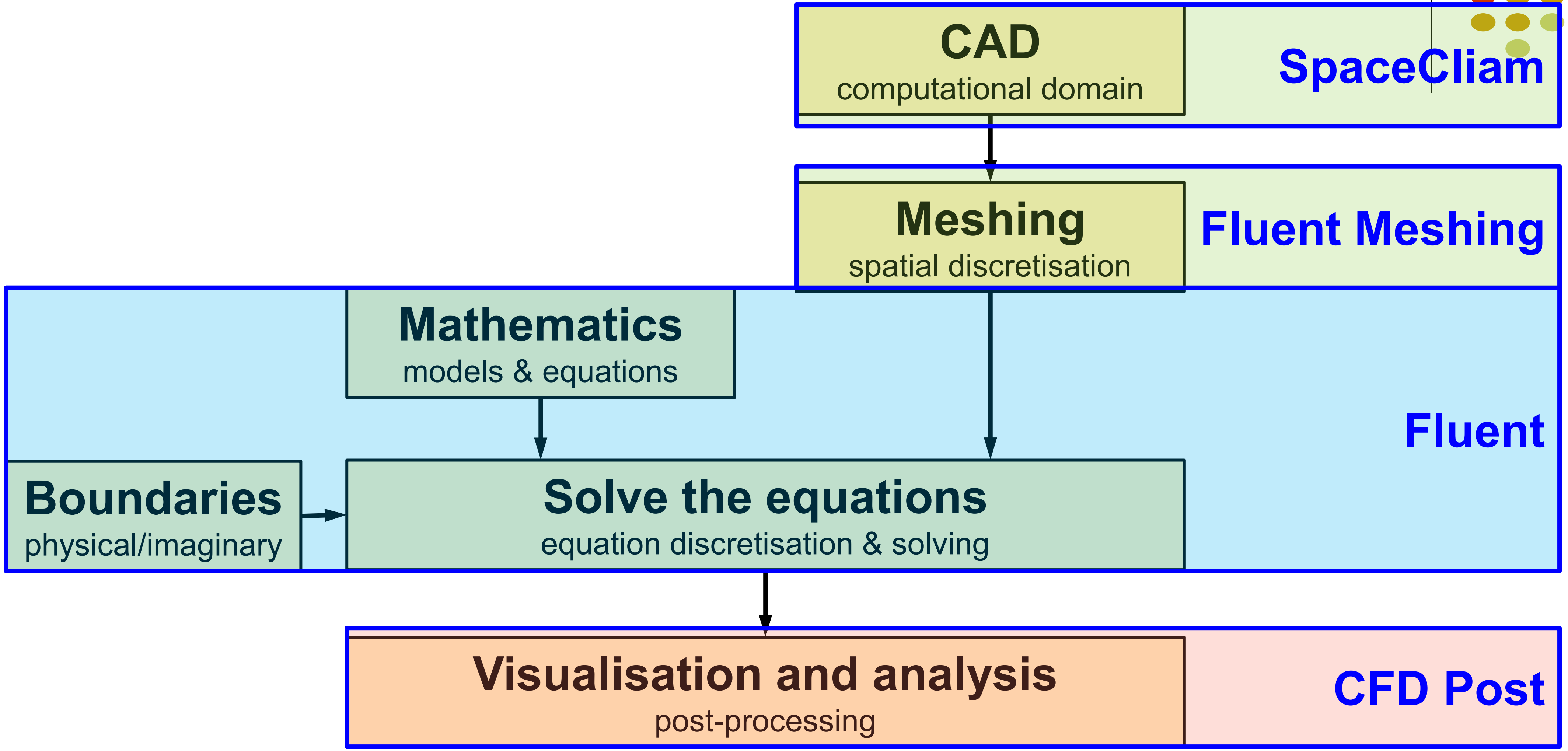
https://www.simscale.com/docs/validation-cases/thermal-comfort-underfloor-air-distribution/

Today's work

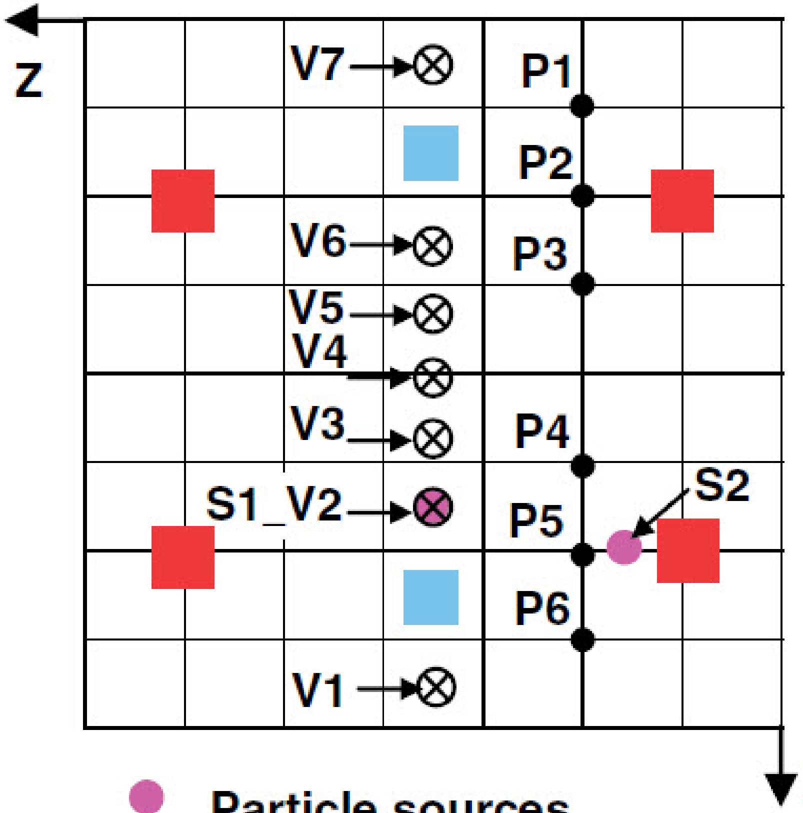


Physics
Interpretation, approximation & data
key features & simplification
CAD
computational domain
estimate the fields
Meshing
spatial discretisation
availability & validity
Mathematics
models & equations
fidelity
Boundaries
physical/imaginary
Solve the equations
equation discretisation & solving
fidelity?
Visualisation and analysis
post-processing
Reporting
Feed in
Feed forward
Feed back

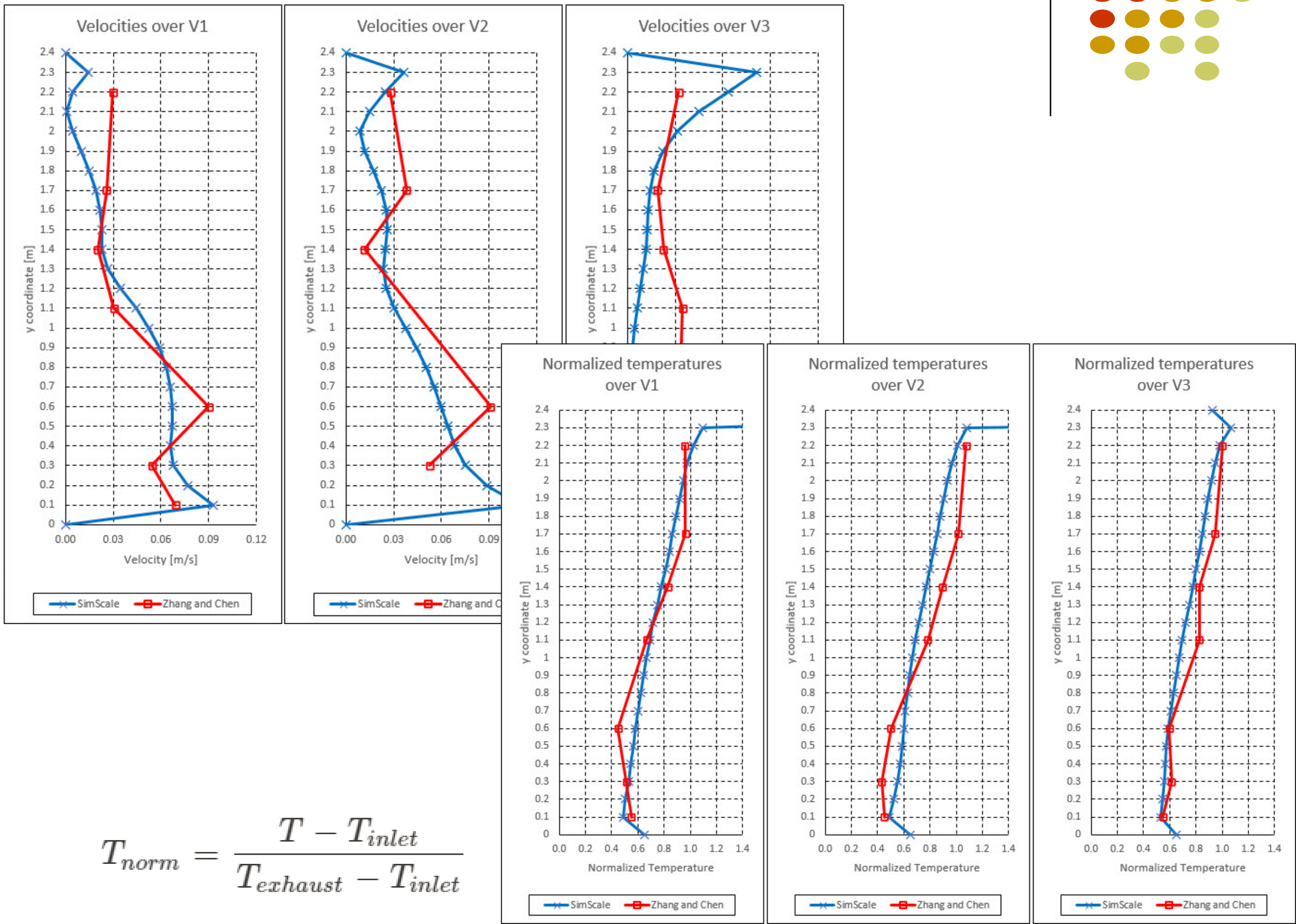
Today's work


CAD
computational domain
SpaceCliam
Meshing
spatial discretisation
Fluent Meshing
Mathematics
models & equations
Fluent
Boundaries
physical/imaginary
Solve the equations
equation discretisation & solving
Visualisation and analysis
post-processing
CFD Post

The computational results



- Particle sources
- Particle measurement
- Velocity measurement



https://www.simscale.com/docs/validation-cases/thermal-comfort-underfloor-air-distribution/

$$T_{norm} = \frac{T - T_{inlet}}{T_{exhaust} - T_{inlet}}$$

LET'S DO IT

Assignment

- ❖ Finish the computation
- ❖ Show the flow field and temperature field
- ❖ Compare your results against the data shown in Slide 10. Are you happy with the results?
- ❖ Analyse what cause the errors
- ❖ Briefly report your results and analysis in no more than two A4 pages (no format requirement)
- ❖ **Submit your report via DingTalk by 5:00 pm Wednesday 29/09/2021**