CFD Applications in Building Design and Planning

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Outline

- Background

  What, why, and how
- Indoor Applications

  Balcony Case
- Outdoor Applications

  Flow around building
- Conclusion

What is CFD?

- Computational Fluid Dynamics
- Divide a space into fine cells
- Predict the fluid motion under certain boundary conditions

What does CFD do?

- Airflow Distribution
- Temperature profile
- Contaminant Transport
- Thermal comfort

Why using CFD?

Existing methods to study fluid dynamics:

- Analytical or simple empirical models

  Not applicable for complex problems
- Full or reduced scale model Experiments

  Expensive, time consuming
- Numerical Methods (CFD)

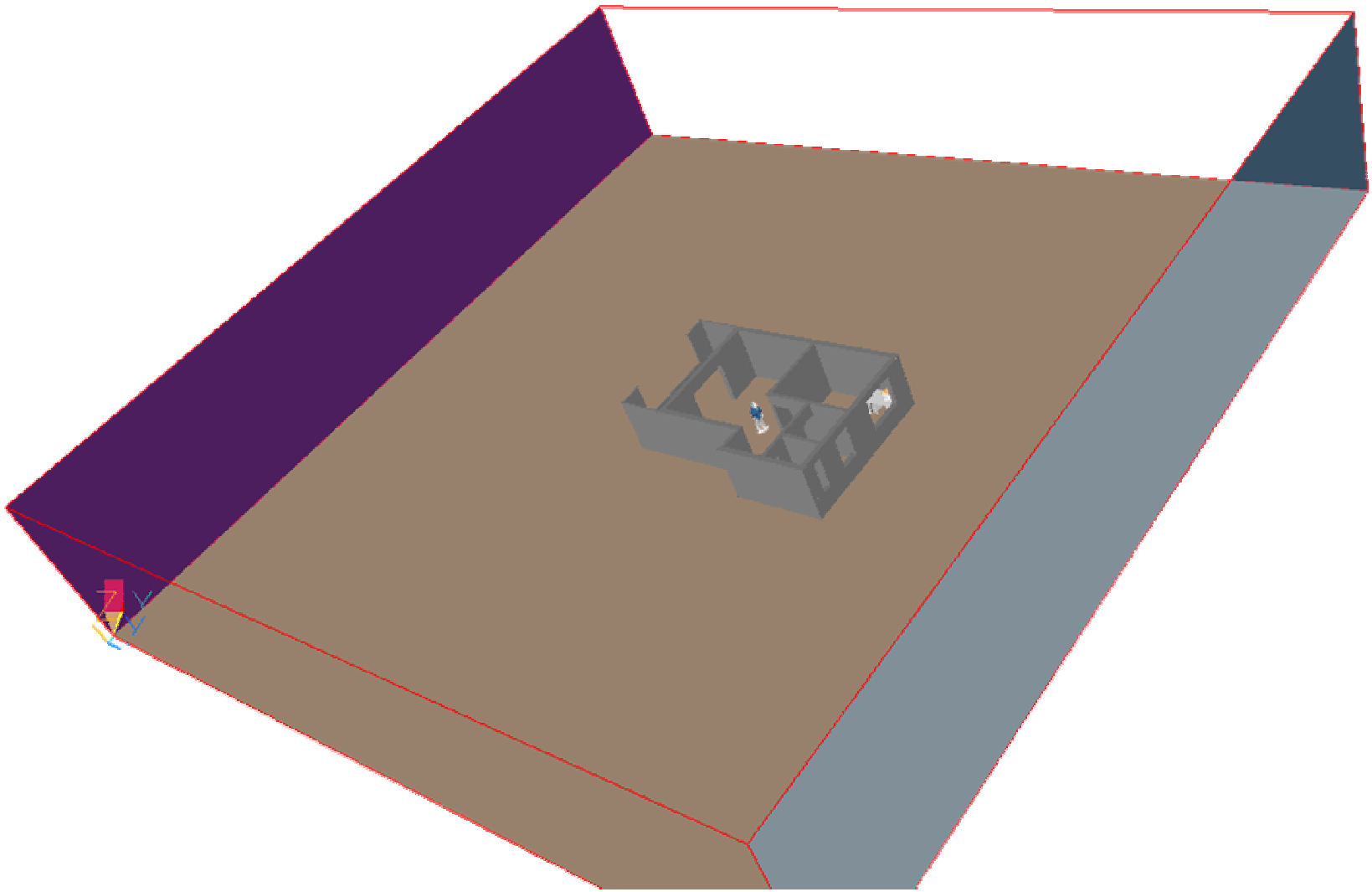
  Inexpensive, fast

How does CFD work?

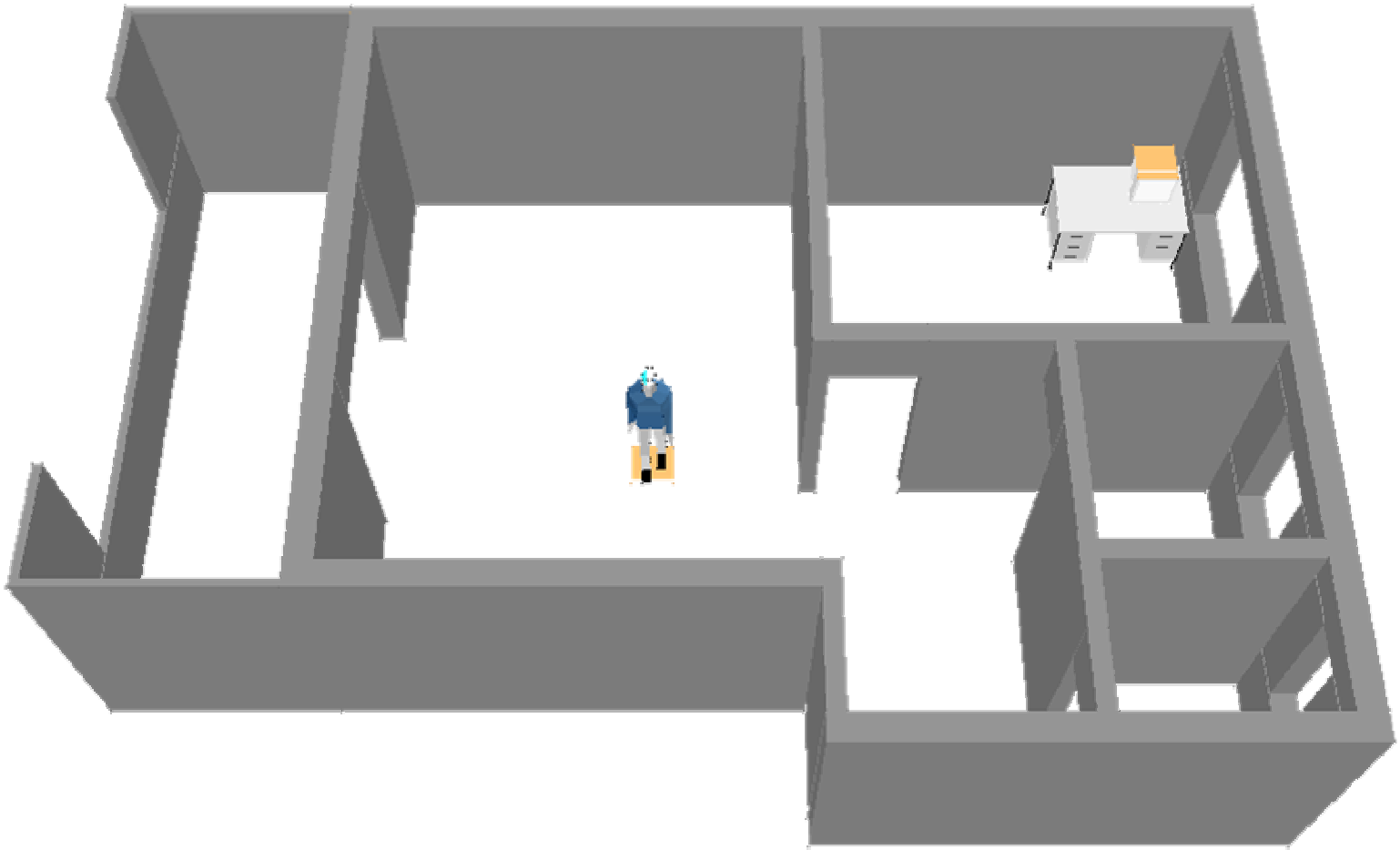
- Geometry input
- Boundary condition
- Preprocessing
- Calculation
- Post processing

Balcony Case

Geometry – Calculation Domain



Geometry – Interior Layout



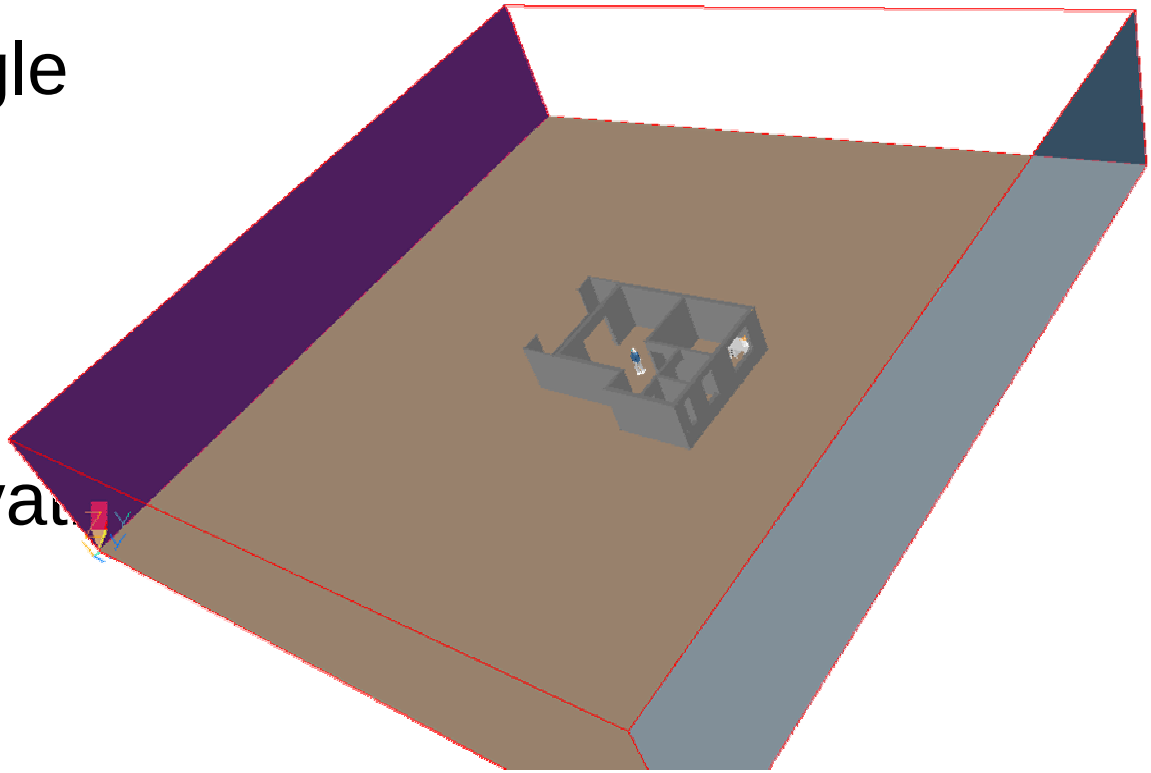
Boundary Conditions - Wind

- Wind direction

  0 incident angle
- Wind velocity

  2.0 m/s
- Outlet

  mass conserva



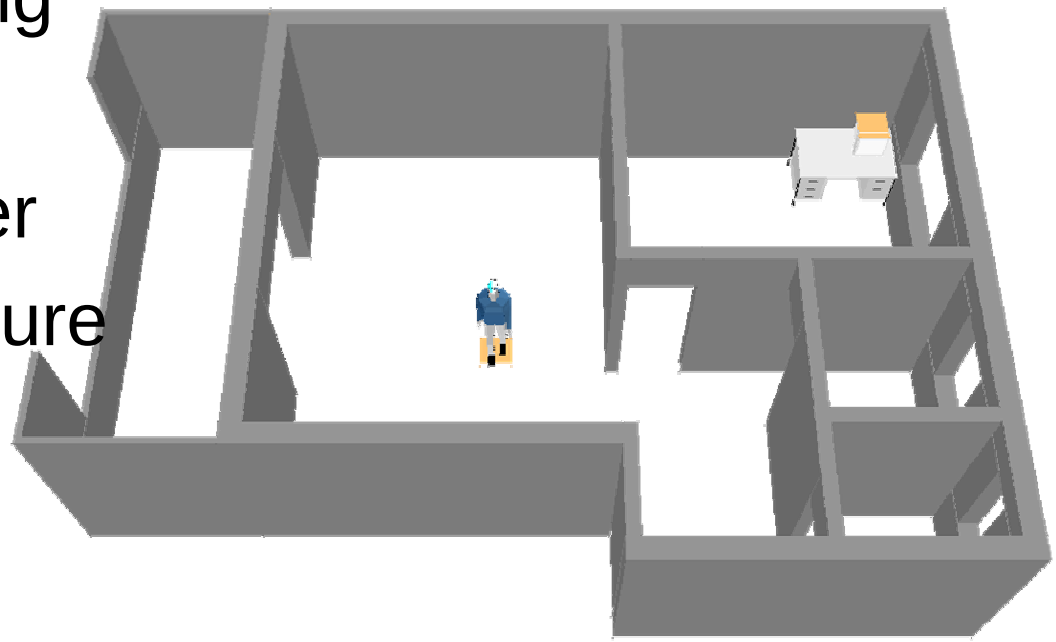
Boundary Conditions – Thermal

- Adiabatic

  Wall, Floor, Ceiling
- Heat source

  Human, Computer
- Surface temperature

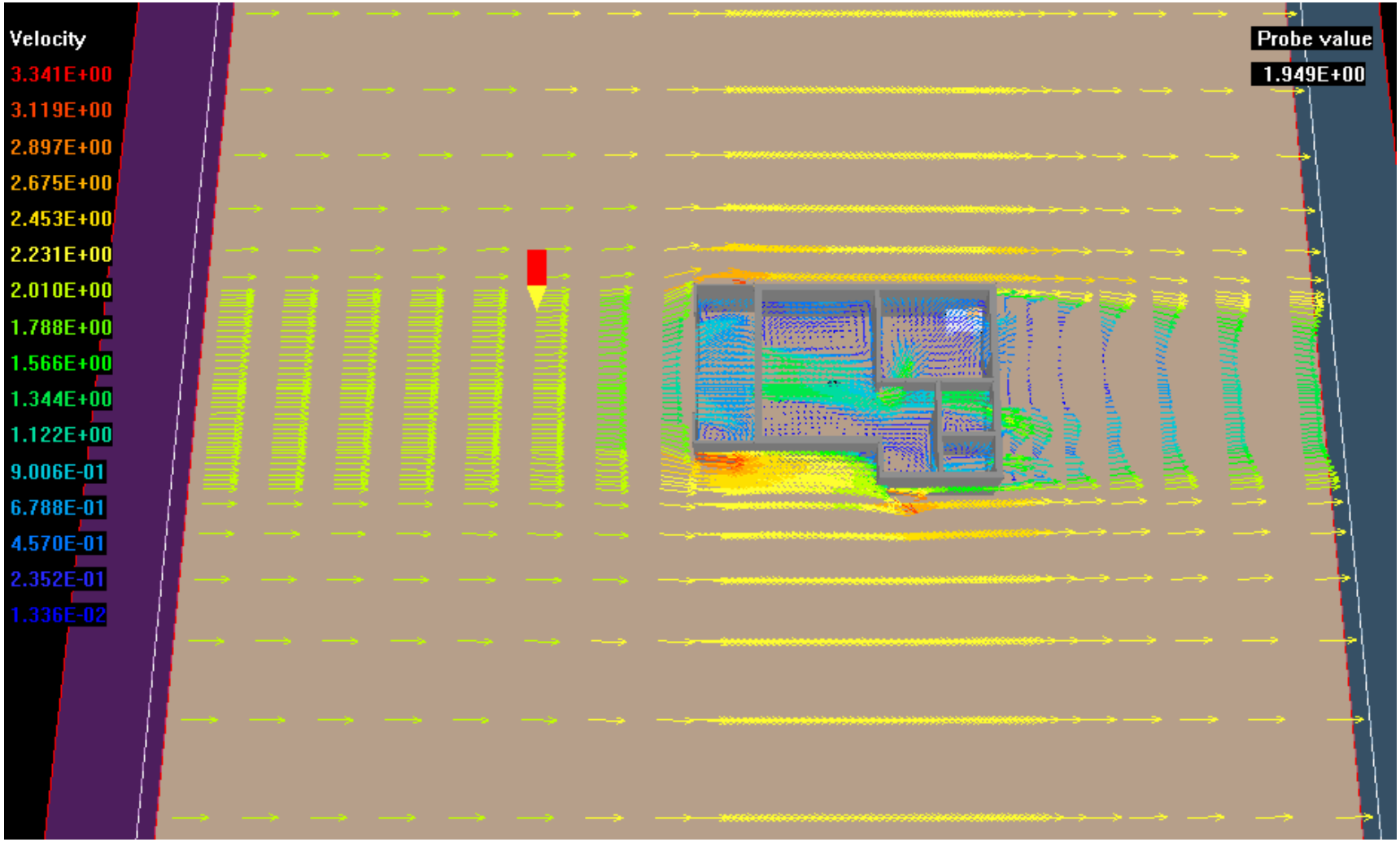
  Wall



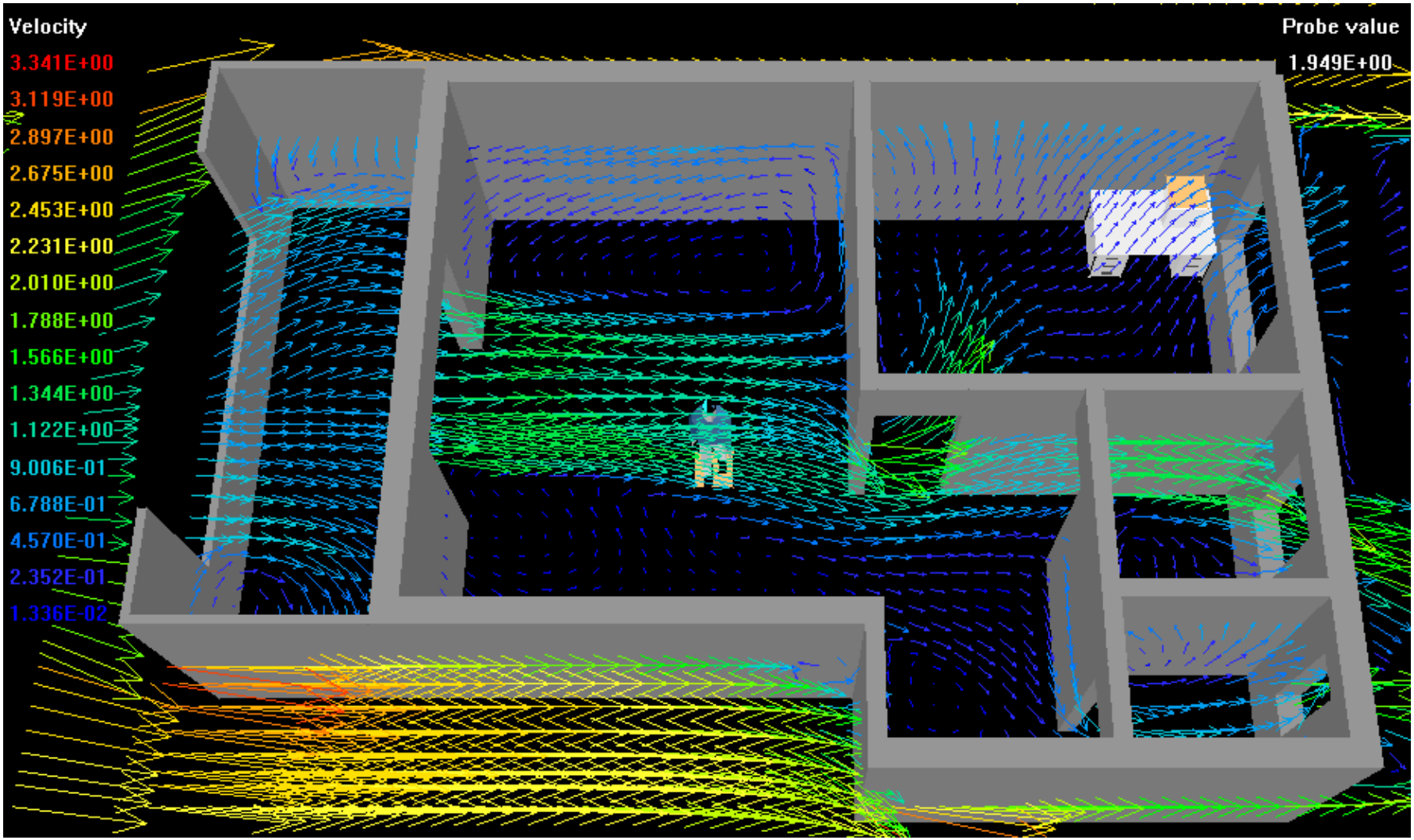
Numerical Settings

- Initial guess value
- Iteration control
- Relaxation control
- Output selection

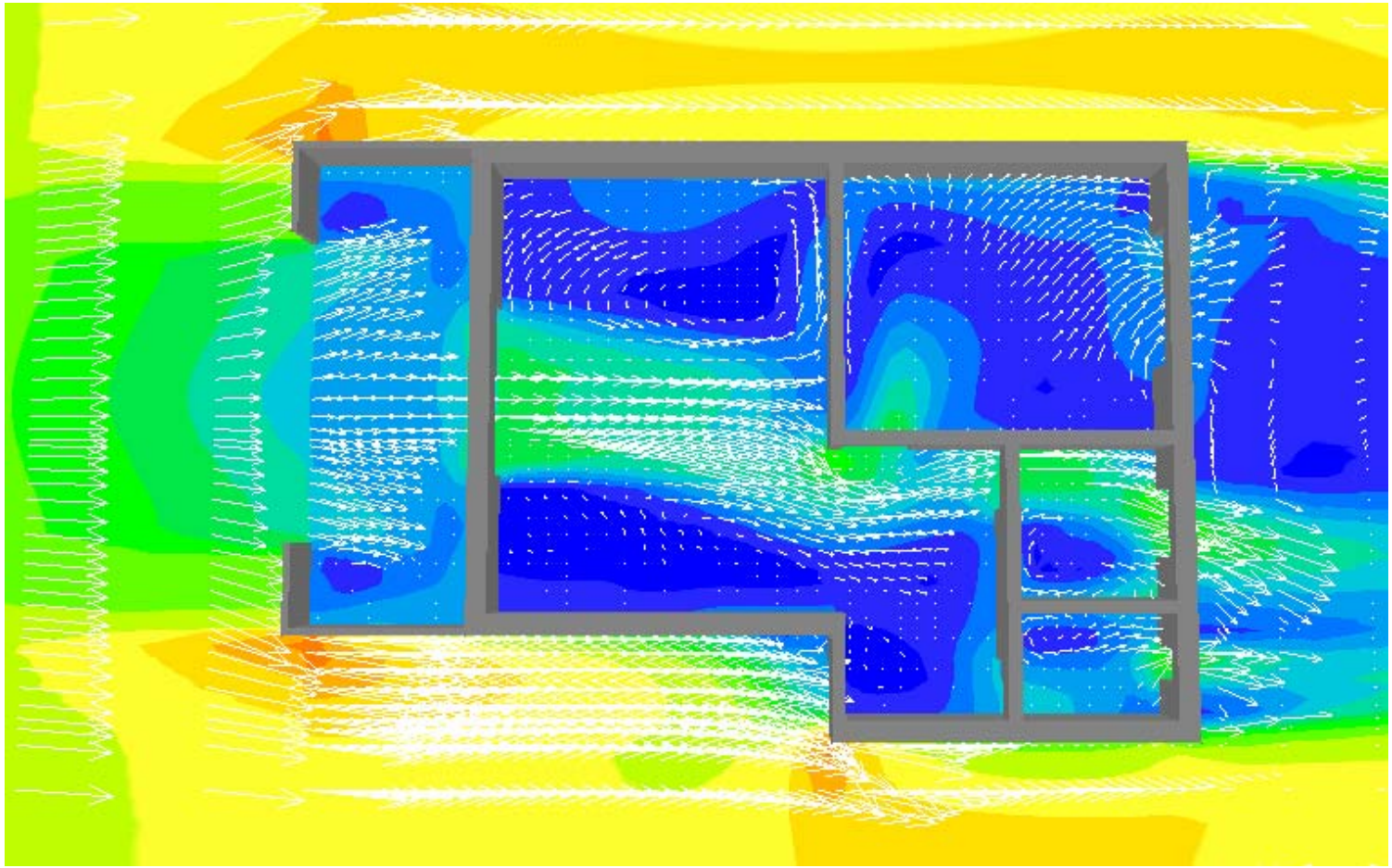
Result – Velocity (Aerial)



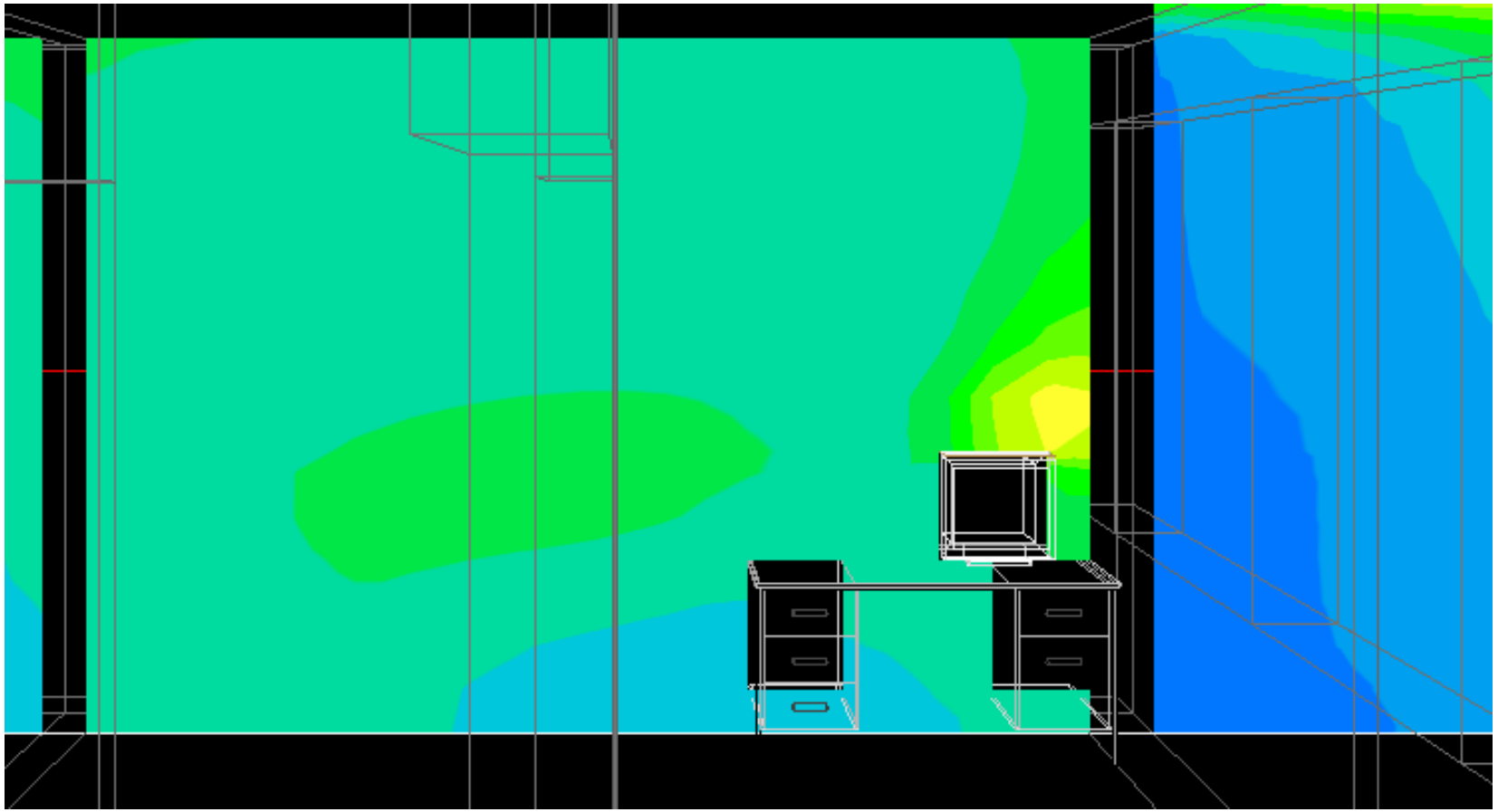
Result – Velocity (Interior)



Result – Flow Visualization



Result – Temperature



Outdoor Airflow