

Week 4 and 5 Progress Report

Anugya Chaubey

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OpenFOAM GUI

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Executive Summary

Goal: Complete Turbulence Model Integration

- ◀ Built a fully data-driven turbulence system
- ◀ Enabled dynamic coefficient editing in UI
- ◀ Connected backend to OpenFOAM file generation
- ◀ Validated full workflow using WSL

Status

90% Complete — One critical bug remaining

Progression from Week 3

System Evolution

Week	Contribution
Week 3	Model selection + UI + persistence
Week 4	Dynamic coefficients + registry system
Week 5	File generation + OpenFOAM integration

Final Pipeline

UI → Backend → Case Writer → OpenFOAM

Files Modified (Week 4 & 5)

File	Change Type	Purpose
CfdTurbulenceModels.py	NEW	Model registry
CfdPhysicsSelection.py	MODIFY	Property updates
TaskPanelCfdPhysicsSelection.py	MODIFY	Dynamic UI
CfdCaseWriterFoam.py	MODIFY	File generation
Templates	MODIFY	Dynamic placeholders

Central Model Registry

CfdTurbulenceModels.py

Category	Models	Coefficients
RANS	kOmegaSST, kEpsilon	Cmu, C1, C2
LES	Smagorinsky, WALE	Ck, Ce
DES	kOmegaSSTDES	Hybrid
Laminar	None	None

Key Idea: Single source of truth → no hardcoding

Helper Functions

Core Functions Added

- ◀ `getModelCoefficients(model)`
- ◀ `getOfKeyword(model)`
- ◀ `getSimulationType(category)`
- ◀ `getModelsForCategory(category)`

Impact

- ◀ Centralized logic
- ◀ Easy to extend
- ◀ Used by both UI and backend

Dynamic Coefficient UI

Core Logic

```
coeffs = getModelCoefficients(model)
saved  = obj.TurbulenceModelCoeffs

for name, default in coeffs.items():
    value = saved.get(name, default)
```

Result: Fully dynamic UI

Backend Property Changes

Property Migration

Property	Type	Purpose
TurbulenceModel	String	Model name
TurbulenceModelCoeffs	Map	Coefficient overrides
PrintCoeffs	Bool	OpenFOAM flag

Key Change

- ◀ Enumeration → String (more flexible)

File Generation Logic

CfdCaseWriterFoam.py

- ◀ Reads model + coefficients from backend
- ◀ Generates turbulenceProperties file
- ◀ Uses dynamic placeholders

Generated Fields

- ◀ simulationType
- ◀ model keyword
- ◀ coefficient block
- ◀ printCoeffs

Generated Output Example

```
simulationType RAS;  
RASModel kOmegaSST;  
  
kOmegaSSTCoeffs  
{  
    alphaK1 0.85;  
    beta1    0.075;  
}
```

WSL Integration

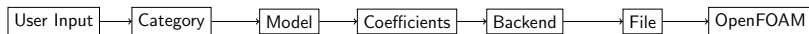
OpenFOAM Integration

- ◀ Connected FreeCAD with WSL Ubuntu
- ◀ Used OpenFOAM v2306
- ◀ Verified full pipeline execution

Pipeline

- ◀ Geometry → Mesh → Physics → Case → Solver

End-to-End Workflow



Critical Bug

Issue: Coefficients = 0.0

- ◀ Default values not used
- ◀ Only user overrides written

Impact

- ◀ Incorrect simulation setup

Bug Fix Strategy

Correct Merge Logic

```
merged = defaults.copy() merged.update(overrides)
```

Result

- ◀ Defaults preserved
- ◀ User values override correctly

Final Week Tasks

Task	Priority
Fix merge bug	High
Validate models	High
Error handling	Medium
Code cleanup	Low

Acceptance Criteria

- ◀ Correct default coefficients
- ◀ User overrides applied
- ◀ `simulationType` correct
- ◀ `printCoeffs` working
- ◀ No runtime errors

Impact

- ◀ Full dynamic turbulence system
- ◀ UI + backend + solver integrated
- ◀ Extensible architecture

Key Achievement

Static → Fully dynamic OpenFOAM integration

Conclusion

- ◀ System nearly complete
- ◀ Only one fix remaining
- ◀ Ready for production after fix