Complete OpenFOAM Case Files for McLaren 2023 Wing

Rigid Wing Case Structure

```
cfd-analysis/rigid-wing/
├── 0/                          # Initial conditions
│   ├── U                       # Velocity field (97.22 m/s X-direction)
│   ├── p                       # Pressure field (101325 Pa)
│   ├── T                       # Temperature field (288.15 K)
│   ├── k                       # Turbulent kinetic energy
│   ├── omega                   # Specific dissipation rate
│   └── nut                     # Turbulent viscosity
├── constant/                   # Case constants
│   ├── thermophysicalProperties   # Compressible flow properties
│   ├── turbulenceProperties       # k-omega SST model
│   └── triSurface/             # Wing geometry
│       └── mclaren_2023_original.stl
└── system/                     # Case setup
    ├── controlDict             # Simulation control (rhoCentralFoam)
    ├── blockMeshDict           # Background mesh (9x5x5 m domain)
    ├── snappyHexMeshDict       # Wing mesh generation
    ├── fvSchemes               # Numerical schemes (compressible)
    └── fvSolution              # Solver settings
```

Key Configuration Details

Flow Conditions (350 km/h Compressible)

- **Velocity**: 97.22 m/s (350 km/h)
- **Mach Number**: ~0.284 (compressible regime)
- **Pressure**: 101325 Pa (sea level)
- **Temperature**: 288.15 K (15°C)
- **Solver**: rhoCentralFoam (density-based compressible)

Mesh Setup

- **Domain**: X[-3 to 6], Y[-2.5 to 2.5], Z[-2 to 3] meters
- **Background cells**: 90×50×50 = 225,000 cells
- **Refinement**: Level 2-3 around wing (conservative for stability)
- **X-direction flow**: Inlet at X=-3, Outlet at X=+6

Turbulence Model

- **Model**: k-ω SST (excellent for automotive aerodynamics)
- **Turbulent intensity**: 5%

- **Turbulent length scale**: 0.1 m
- **Wall functions**: For boundary layer treatment

Boundary Conditions

- **Inlet**: Fixed velocity (97.22, 0, 0) m/s
- **Outlet**: Fixed pressure 101325 Pa
- **Walls**: No-slip condition
- **Wing surface**: No-slip with wall functions

Running the Case

1. Setup Case

```bash
cd cfd-analysis/rigid-wing

# Copy STL file
cp ../../geometry/mclaren_2023_original.stl constant/triSurface/

# Generate background mesh
blockMesh

# Generate wing mesh
snappyHexMesh -overwrite
```

2. Initialize Flow

```bash
# Set up compressible initial conditions
```