

# Nick Morse

## Curriculum Vitae

+43 660 404 6155  
ntmorse4@gmail.com  
z.umn.edu/nick-morse  
Date of birth: 14.04.1996  
Language: English  
Citizenship: USA  
Graz, Austria



Researcher with expertise in large-eddy simulation and direct numerical simulation of turbulent boundary layers, jets, and multiphase flows.

## Education

- 2023 **PhD**, *Aerospace Engineering & Mechanics*, University of Minnesota  
Thesis: "High-fidelity unstructured overset simulation of complex turbulent flows" [↗](#)  
Adviser: Professor Krishnan Mahesh
- 2020 **MS**, *Aerospace Engineering & Mechanics*, University of Minnesota
- 2018 **BAEM**, *Aerospace Engineering & Mechanics*, University of Minnesota  
Minors: Math, Astrophysics

## Skills

<i>Programming</i>	HPC, Fortran, Python, MATLAB, MPI, Make, Shell, Git	<i>Engineering</i>	OpenFOAM, SolidWorks, ANSYS, Simulink
<i>Meshing</i>	Pointwise, GridPro, Salome, Gmsh	<i>Visualization</i>	ParaView, Tecplot, Blender, PyVista
<i>Office</i>	L <sup>A</sup> T <sub>E</sub> X, Microsoft Office	<i>Manufacturing</i>	Lathe, mill, waterjet, composites

## Experience

- 2023–Present **Senior Scientist**, *Research Center Pharmaceutical Engineering*, Graz, Austria
- Led the simulation strategy development for an EU Horizon 2020 project.
  - Coded a boundary element method from scratch to resolve sub-Kolmogorov-scale droplet breakup.
    - *Discretization*: Unstructured Lagrange 6-point triangular cells, Gauss-Legendre quadrature, feature-preserving adaptive cell refinement, curvature-adaptive Laplacian mesh smoothing.
    - *Numerics*: Adaptive RK2 time stepping, matrix-free GMRES(k), Wielandt eigenvalue deflation, fast multipole method with Green's function singularity subtraction.
    - *I/O*: VTK binary solution files, Gmsh binary grid files, automatic icosahedron grid generation.
  - Implemented an ethanol-water mixture model in OpenFOAM to simulate impingement jet mixing.
- 2018–2023 **Graduate Research Assistant**, *University of Minnesota*, Minneapolis, MN, USA  
*Computational Fluids Lab* (Professor Krishnan Mahesh)
- Performed large-scale (>10000 processor) simulations of complex turbulent flows using HPC.
    - Derived axisymmetric streamline coordinates to analyze boundary layer curvature effects in a large-eddy simulation (LES) of a turbulent boundary layer on an axisymmetric body.
    - Resolved the trip wires on an appended hull to analyze boundary layer memory effects in LES.
    - Identified mixing-enhancing secondary vortices from direct numerical simulation (DNS) and dynamic mode decomposition (DMD) of a jet in crossflow.
  - Extended an in-house unstructured finite-volume overset LES/DNS method in Fortran/MPI.
    - Implemented support for *hypr* GPU solvers with minimized LHS matrix reconstruction.
    - Added non-orthogonal Crank-Nicolson viscous flux correction and LES source terms.
    - Created grid cutting and hierarchy algorithms for overset assembly of grids for complex geometries.
- 2016–2017 **Undergraduate Research Assistant**, *University of Minnesota*, Minneapolis, MN, USA  
*Turbulent Shear Flow Lab* (Professor Ellen Longmire)
- Designed wax-iron oxide spheres to study particle transport in a turbulent boundary layer.
  - Characterized the particle restitution coefficient's Stokes number dependence using high speed cameras and MATLAB image analysis.
  - Measured vibrations of a water tunnel traverse system to investigate PIV imaging errors.

2014–2019 **Chief Engineer & Aerodynamics Designer**, *University of Minnesota Formula SAE*

- Led weekly meetings of a team of 70 members and directed systems-level car design targets.
- Programmed a MATLAB graphical user interface to parameterize multi-element wing profiles.
- Automated large-scale ANSYS CFX simulations at the Minnesota Supercomputing Institute.

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## Publications

### Journal articles

**N. Morse** and K. Mahesh. Tripping effects on model-scale studies of flow over the DARPA SUBOFF [↗](#). *Journal of Fluid Mechanics*, 975:A3, 2023.

**N. Morse** and K. Mahesh. Effect of tabs on the shear layer dynamics of a jet in cross-flow [↗](#). *Journal of Fluid Mechanics*, 958:A6, 2023.

**N. Morse** and K. Mahesh. Large-eddy simulation and streamline coordinate analysis of flow over an axisymmetric hull [↗](#). *Journal of Fluid Mechanics*, 926:A18, 2021.

### Conference papers & abstracts

**N. Morse**, J. Remmelgas, and J. Khinast. A simulation framework for nanodroplet breakup in top-down nanoparticle production [↗](#). In *AICHE Annual Meeting*, 2024.

M. Fenelon, Y. Zhang, L. Cattafesta, **N. Morse**, K. Mahesh, L. Li, and Z. Pan. Optimized timing schemes for multi-pulse shake-the-box particle tracking velocimetry [↗](#). In *AIAA SciTech Forum*, 2023.

**N. Morse** and K. Mahesh. The shear layer structure of a tabbed jet in crossflow [↗](#). In *75th Annual Meeting of the APS DFD*, 2022.

M. Fenelon, L. Cattafesta, Y. Zhang, K. Mahesh, and **N. Morse**. Optimizing dt for MP-STB in particle tracking velocimetry [↗](#). In *75th Annual Meeting of the APS DFD*, 2022.

**N. Morse**, T. Kroll, and K. Mahesh. Large-eddy simulation of submerged marine vehicles [↗](#). In *Proceedings of the 34th Symposium on Naval Hydrodynamics, Washington, DC*, 2022.

**N. Morse** and K. Mahesh. Streamline coordinate analysis of the flow past an axisymmetric body computed by large-eddy simulation [↗](#). In *74th Annual Meeting of the APS DFD*, 2021.

**N. Morse** and K. Mahesh. Large-eddy simulation of appended submerged vehicles using an unstructured overset grid method [↗](#). In *73rd Annual Meeting of the APS DFD*, 2020.

T. Kroll, **N. Morse**, W. Horne, and K. Mahesh. Large eddy simulation of marine flows over complex geometries using a massively parallel unstructured overset method [↗](#). In *Proceedings of the 33rd Symposium on Naval Hydrodynamics, Osaka, Japan*, 2020.

**N. Morse**, W. Horne, and K. Mahesh. Towards large-eddy simulation of maneuvering vehicles using an unstructured overset grid method [↗](#). In *72nd Annual Meeting of the APS DFD*, 2019.

D. Barros, Y. H. Tee, **N. Morse**, B. Hiltbrand, and E. Longmire. Investigation of particle lift off in a turbulent boundary layer [↗](#). In *70th Annual Meeting of the APS DFD*, 2017.

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## Service

2025 Co-organizer of an international workshop at the *Banff International Research Station*: “Particulates across Scales: Mathematical Modeling, Computation, and Applications” [↗](#)

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## References

Professor Krishnan Mahesh

[krmahesh@umich.edu](mailto:krmahesh@umich.edu)

University of Michigan

Professor Ellen Longmire

[longmire@umn.edu](mailto:longmire@umn.edu)

University of Minnesota

Dr. Praveen Kumar

[praveen.kumar9@ge.com](mailto:praveen.kumar9@ge.com)

GE Global Research

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## Interests

Mountain biking, road cycling, skiing, running, hiking, tennis, bouldering