

# Nidhoggr Technical Reference Manual

Cody Raskin

April 25, 2025

v0.8.0

# Contents

1	Introduction	4
2	Software Architecture	4
3	Data Structures	4
4	Numerical Methods	4
5	Physics Models	4
6	I/O and Post-Processing	5
7	Extending Nidhoggr	5
8	Coding Standards and Guidelines	5
9	Known Limitations and Future Work	5
A	Appendix A: Class Hierarchies	5
B	Appendix B: Developer Tools	5

# **1 Introduction**

- Purpose and Scope
- History and Development Goals
- Overview of Physical Models

# **2 Software Architecture**

- High-Level Code Organization
- Major Modules and Dependencies
- Build System (CMake, etc.)

# **3 Data Structures**

- Mesh and Grid Classes
- Field Representations
- Boundary Condition Structures
- Material and Equation-of-State (EOS) Models

# **4 Numerical Methods**

- Finite Element Methods (FEM)
- Smoothed Particle Hydrodynamics (SPH)
- Solvers (linear, nonlinear, iterative)
- Time Integration Schemes

# **5 Physics Models**

- Hydrodynamics
- Solid Mechanics
- Damage and Fracture Modeling
- Radiation Transport (if applicable)

## **6 I/O and Post-Processing**

- Input File Formats
- Output File Formats (VTK, Silo, etc.)
- Restart and Checkpointing
- Visualization Recommendations

## **7 Extending Nidhoggr**

- Adding New Material Models
- Adding New Boundary Conditions
- Implementing New Solvers
- Adding New Output Types

## **8 Coding Standards and Guidelines**

- Naming Conventions
- Best Practices for Contributions
- Testing and Validation Procedures

## **9 Known Limitations and Future Work**

- Current Limitations
- Planned Features

## **A Appendix A: Class Hierarchies**

- UML-style Diagrams (optional)

## **B Appendix B: Developer Tools**

- Debugging Tools
- Profiling and Performance Analysis