

# Applications of Lightweight Formal Methods in Engineering Software

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## Abstract

Boop.

## 1 Introduction/Background

Called a third pillar science, computation is an indispensable tool not only for scientists, but for engineers who simulate physical and natural processes to evaluate design alternatives. Recent studies on reliability, reproducibility of results, and productivity have cast concern over what many have suspected or experienced firsthand, that existing practices of constructing scientific software are inadequate and limiting the pace of technological advancement. A disconnect between modern software engineering practice and scientific computation is apparent, and yet the unique challenges facing developers of scientific software must also be recognized: the lack of test oracles, software lifetimes and evolving needs that span decades, and the competing objectives of performance, maintainability, and portability.

I seek to address fundamental design and quality assurance challenges that are intrinsic to scientific computation and related types of numerical software. While numerous directions might be taken, our premise and motivating viewpoint is the central role that modeling can and must play in the process of

designing and working with complex artifacts, including scientific programs.  
Culturally, the fit may be a natural one: scientists and engineers are accustomed  
25 to working with models anyway, and with the kind of automatic, push-button  
analysis supported by some state-based formalisms, those who develop software  
can focus on modeling and design instead of theorem proving.

## 2 Problem Statement

The goal of this research is to establish the role of lightweight formal methods  
30 in scientific and engineering software design.

## 3 Literature Review

Daniel Jackson.

## 4 Methodology

Find common programming paradigms in scientific software design and model  
35 them.

## 5 Overview of Chapters

- Moment distribution
- Sparse matrices
- Finite element
- 40 • User interface design
- Mesh editing and rendering
- Utilities for Alloy

## **6 Plan of Work**

Get it all done this year.

## <sup>45</sup> **7 Bibliography**

Citations.

## **8 Appendices**

Papers we've already written.