

Matt Fago

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EDUCATION

California Institute of Technology, Pasadena, CA **4.0/4.0 grade point**

PhD in Aeronautics, minor in Materials Science, June, 2004

Master of Science in Aeronautics, June, 1999

Field of study: computational solid mechanics, Advisor: Michael Ortiz

Thesis: "Constrained Sequential Lamination: Nonconvex Optimization and Material Microstructure"

Experience includes:

- C/C++/Java/Fortran, Linux/Unix, massively parallel computing, computer graphics, meshing
- Optimization, nonlinear finite elements, multiscale material modeling, computational physics

University of Michigan, Ann Arbor, MI **3.96/4.0 grade point**

Aerospace Engineering BSE, August, 1995

Mechanical Engineering BSE, December, 1995

Research and design experience includes:

- Conducted independent research of shell vibration and composite failure using holography
- Contributed to the preliminary design of a Neptune Orbiter spacecraft
- Completed projects in Mechanical Design, Structural Mechanics and Aerospace Laboratory

INDUSTRY EXPERIENCE

Northrop Grumman Space Technology, Redondo Beach, CA **10/2003–4/2005**

- Analyzed the dynamics of a space telescope prototype for the SVMV R&D program
- Development of parallel C++ spectral element code for efficient frequency response analysis
- Active SSBI/SCI clearance

Lawrence Livermore National Labs, Livermore, CA **Guest 7/2002–10/2002**

- Modeled void growth in thin Copper films using molecular dynamics
- Developed molecular dynamics model of thin film bending stiffness

Lockheed Martin Astronautics, Denver, CO **1/1996–9/1998**

- Developed system level finite element model of Mars 2001 Orbiter
- Developed Phase A spacecraft configuration model of Mars 2001 Orbiter
- Conducted detailed structural analysis in support of design trades
- Designed and analyzed spacecraft structural components and assemblies, Mars Surveyor 1998
- Obtained in-depth experience with SDRC I-Deas and MSC Nastran
- Interfaced with composites lab, prototyping shop and precision alignment lab

Nicolet Instruments, Madison, WI **Summer Intern 1990–1994**

- Designed mechanical components of three products as project mechanical engineer
- Designed and constructed operational prototypes of mechanical and optical components
- Created and implemented tests to qualify performance of optical components
- Resolved design problems and redesigned components for cost reduction

HONORS

DOE Computational Science Graduate Fellowship

Lockheed Martin Employee Commendation for Phase A work on Mars 2001

Edward A. Stalker Undergraduate Research Fellowship, summer 1995

Nicolet Instruments Hi-Step scholar: internship and scholarship

Branstrom Prize for top 5% of freshman in 1991, Angell Scholar and Dean's Honor list

RESEARCH INTERESTS

- Computational solid mechanics
- Structural analysis and design
- Computational geometry and computer graphics
- Multiscale modeling with wavelets and subdivision surfaces
- Application of *ab initio* material models to structural analysis
- MEMS analysis and design tools
- Optimization

RESEARCH SUMMARY

Sequential lamination of martensitic materials

Implemented a model to simulate martensitic phase transformations at the subgrid level of a finite element simulation. Sequential lamination is used to construct the partial relaxation of a multiwell energy density, and provides microstructures that are in static and configurational equilibrium. The laminate topology evolves during deformation through branching and pruning operations, while a continuity constraint provides a simple model of metastability and hysteresis.

Local-Quasicontinuum Density Functional Theory

Co-developed a material model that utilizes *ab initio* material properties computed in real-time during a finite element calculation. The material behavior is modeled, through the Cauchy-Born assumption, as individual non-interacting unit-cells at each mesh integration point. Density Functional Theory is used to compute the stresses and energies, with the global solution fields obtained through energy minimization. This approach allows for the prediction of phase changes and the effects of alloy composition, and simulation under large ranges of stresses.

Finite temperature quasicontinuum method

Extending the quasicontinuum method to finite temperatures. The quasicontinuum method is a multiscale generalization of molecular dynamics that uses representative atoms to model regions where fields vary slowly, while seamlessly transitioning to atomistic resolution where required. Finite temperature effects are included by using a Langevin thermostat to provide a first approximation to the thermal motion of the atoms.

NiTi phase transformation under dynamic loading

Kolsky bar experiments investigating the phase transformation behavior of a superelastic Nickel Titanium shape memory alloy under dynamic loading.

Edge delamination in laminated composites

Experimental investigation of void growth in laminated composite panels using holographic interferometry.

PUBLICATIONS

Prediction of dislocation nucleation during nanoindentation by the orbital free Density Functional Theory based local quasicontinuum method. R.L. Hayes, M. Fago, M. Ortiz and E.A. Carter. *Multiscale Modeling and Simulation*, 4(2):359–389, 2005.

Density functional theory based local quasicontinuum method: Prediction of dislocation nucleation. M. Fago, R.L. Hayes, E.A. Carter, and M. Ortiz. *Physical Review B*, 70:100102, 2004.

A constrained sequential lamination algorithm for the simulation of sub-grid microstructure in martensitic materials. S. Aubry, M. Fago, and M. Ortiz. *Computer Methods in Applied Mechanics and Engineering*, 192(26–27):2823–2843, 2003.

Experimental investigation of the behavior of edge delaminations using holographic interferometry. M.J. Fago and A.M. Waas. *Optical Engineering*, 37:1420–1428, 1998.

CONFERENCES AND PRESENTATIONS

Local quasicontinuum density functional theory. M. Fago, R.L. Hayes, E.A. Carter, M. Ortiz. 7th US National Congress on Computational Mechanics, 2003.

A constrained sequential-lamination algorithm with applications to plasticity and shape memory alloys. M. Ortiz, S. Aubry, M. Fago. COMPLAS 2003.

Simulation of laminated microstructures in martensitic materials. S. Aubry, M. Fago, M. Ortiz. ASCI review poster presentation, October, 2002.

Density functional theory as a finite element constitutive model. M. Fago, M. Ortiz, R.L. Hayes, E.A. Carter. CSGF conference poster session, 2002.

Finite element simulation of laminated microstructures in shape memory materials. M. Fago, S. Aubry, M. Ortiz. CSGF conference poster session, 2001.