Gokul Hariharan,

Ames, IA. | gokul@iastate.edu | LinkedIn | Google Scholar

Summary

I work for the **Autonomous Systems group** led by Prof. Wongpiromsarn, and also closely collaborate with the **Temporal Logic group** led by Prof. Rozier. We ensure safety of autonomous systems using formal methods (funded in part by NASA and NSF). Methods include both (online and offline) **verification of systems**, and designing new systems that are **safe by construction**.

I know and use these **Formal Methods** tools: Isabelle, SPIN, NuXmv, NuSmv, and Z3, and these verification techniques: satisfiability checking, runtime verification, model checking, and specification simulation and debugging. To the best of my knowledge, **we were the first** to develop a feasible approach to solve the **MaxSAT problem in temporal logic** for feature prioritization in designing safe systems. I am currently working on applications of Formal Methods to Robotics, and **verified quantum algorithms** and circuit synthesis. I would like to pursue a career in Formal Methods.

I am adept at many programming languages: C, C++11, Python, and OCaml to name a few. I have good knowledge about **compilers** and **interpreters**, **parsing** languages using **OCaml (Menhir)** and **Antlr**, and cross compiling code sourced from various languages. I know about **Lean** and **COQ** by attending many presentations, but I mostly used **Isabelle** as a proof assistant for my projects.

I am a strong teammate, I collaborate freely, share anything that might help, and I learn what is needed to bring out the best from the team.

Experience

Research Assistant
Iowa State University   Jan 2021 - Present (10 months +)

- Project 1: A new temporal logic that accounts for **signals of different types** (completed)
- Project 2: The first to solve for the **Maximum Satisfiability** of temporal logic specifications (completed)
- Project 3: **Parallel version** of fast MaxSAT translations to Boolean logic (ongoing)
- Project 4: Synthesis of correct **quantum algorithms** using **formal methods**. (ongoing)

Technologies: • Formal methods for robotics, autonomous, cyber-physical systems, quantum algorithms, and software. • Design optimization (Integer linear programming, MaxSAT). • Specification synthesis, verification, debugging. • C++, Python, OCaml, Antlr, Menhir, Isabelle, NuXmv, Z3.

Postdoctoral Researcher
University of Southern California   Apr 2020 – Dec 2020 (9 months)

- Advanced Control theory and machine learning to control flow transition in channel flows

Research Assistant
University of Minnesota Twin Cities   Jan 2016 - Apr 2020 (4 years 4 months)

- Carried out direct numerical simulations, codes used C++
- Used Matlab, Mathematica, Python, for analytical, numerical and statistical analysis of results

Teaching Assistant
University of Minnesota Twin Cities   Jan 2019 - May 2019 (5 months), Sep 2018 - Dec 2018 (4 months)

- Held discussions and proctored exams for two graduate-level courses, Linear Algebra and Fluid Mechanics.

Research Assistant

Indian Institute of Technology, Delhi   Jan 2014 - Jun 2015 (1 year 6 months)

- Simulated the influence of ash on coal particles during fluidization using Discrete Element Modeling (DEM).
- Tracked coal and ash movements using Molecular-Dynamics-like Simulations (MDS) using C++
- Leveraged Computational Fluid Dynamics (CFD) in C
- Won the best poster award in Open House – 2015, IIT Delhi

Research Intern

BITS Pilani, Hyderabad Campus   May 2011 - Jun 2011 (2 months)

- Optimal solution between two conflicting objectives in job scheduling using ANN
- Used ANN to predict flow stress in the dynamic strain aging regime of austenitic stainless steel 316

Education

Iowa State University
Doctor of Philosophy (Ph.D.), Computer Science | GPA: 3.93/4.0 2021 - 2023
Specialization in Formal Methods and Robotics (Perception, Planning, Localization, Control)

University of Minnesota
Doctor of Philosophy (Ph.D.), Chemical Engineering | GPA: 3.46/4.0 2015 - 2020
Specialization in Fluid Mechanics, Numerical Methods, CFD, FEM, etc.

Indian Institute of Technology Delhi
Master of Technology (M.Tech.), Chemical Engineering | GPA: 3.8/4.0 2013 - 2015

National Institute of Technology Warangal
Master of Technology (M.Tech.), Chemical Engineering | GPA: 3.8/4.0 2013 - 2015

Honors and Awards

F Wendell Miller Scholarship – Department of Computer Science, Iowa State University, Jan 2021
CEMS Outstanding TA Award - CEMS, University of Minnesota, Jun 2019
Sebastian C. Reyes Fellowship - CEMS, University of Minnesota Jan 2016
Stephan J. Salter Fellowship - CEMS, University of Minnesota Jan 2016
Certificate of Excellence - Chemical Engineering Society, IIT Delhi, 2015 Department rank 1 (of 25)
Best Research Poster Award - Open House 2015 - Indian Institute of Technology Delhi 2015
Roll of Honor Gold Medal - National Institute of Technology Warangal, 2013, Department rank 1 (of 100)

Expertises and Skills

Formal Methods • Automated Reasoning • Motion Planning • Satisfiability Checking • Model Checking • Robotics • ROS • Requirements Debugging • Spin • NuSMV • Isabelle • Theorem Proving • OCaml • C++ (11) • Python • Javascript • Java • Mathematica • Matlab • Git • CUDA • OpenMP • OpenCV • WebGL • ANN • Computer Vision • Computational Fluid Dynamics (CFD) • Creative Problem Solving • Attention to Detail • Scientific Writing • Linear Systems Theory • Nonlinear Analysis • Applied Mathematics • Modeling and Simulation • Parallel Programming

Recent Papers

G. Hariharan, P. H. Jones, K. Y. Rozier and T. Wongpiromsarn. Maximum Satisfiability of Mission-time Linear Temporal Logic. In Proceedings of the 21th International Conference on Formal Modeling and Analysis of Timed Systems (FORMATS), Belgium, September 2023 (accepted, 43% of submissions accepted) (Artifact)(PDF).

G. Hariharan, B. Kempa, T. Wongpiromsarn, P. H. Jones, and K. Y. Rozier. MLTL Multi-type (MLTLM): A Logic for Reasoning about Signals of Different Types. In Proceedings of the 15th International Workshop on Numerical Software Verification (NSV), a workshop of FLoC. Springer, Haifa, Israel, August 11, 2022 (Artifact)(PDF).

B. Kempa, **G. Hariharan**, T. Wongpiromsarn, P. H. Jones, and K. Y. Rozier. Applications of MLTLM in System Design and Verification. (In preparation)

Visit https://gokulhari.github.io/webpage/Papers for a full list of papers and presentations, and here for citations.