

# Zahra Forootaninia

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## RESEARCH **Guiding simulation of dynamic phenomena:**

**Fluid guiding:** I proposed an efficient method to guide the dynamic of a flow by manipulating its velocity field in the frequency-domain. By combining the high-frequency component of the simulated velocity field with the low-frequency component of the input guiding velocity field, I could address the problem of mismatched flow behavior during the up-scaling stage of the fluid animation. My method of guiding produces high-quality results with very little computational overhead. I am continuing the work on the guiding problem of fluids by utilizing the machine learning models in order to achieve interactive high-resolution fluid simulation (**C++**, **Python**, **PyTorch**)

**Multi-agent navigation:** I utilized a statistical-mechanical model governing pedestrian motion for multi-agent navigation. I developed two specific models that account for uncertainty in the future trajectories of interacting agents: an isotropic model which conservatively considers all possible errors, and an anisotropic model that assumes the error is only in a direction towards a head-on collision. (**C++**, **Python**)

### **Radio luminosity function and galaxy evolution:**

Using the Very Large Array (VLA) radio telescope to acquire data for a large cluster of galaxies (Abell 2256), I created images and a catalog of galaxies and performed statistical analysis on the data in order to determine the dynamical properties of the cluster. (**Python**, **Numpy**, **CASA**)

## WORK EXPERIENCE

**Summer Intern/ Radar Section** Jet Propulsion Laboratory, May - August 2020

Updating DopplerScatt onboard processing - I transferred the most expensive part of the Python processing code to C++ and bind it to the rest of the original code using Pybind 11 to get some speed up. As well as, adding new visualization to the existing GUI.

**Summer Intern/ Radar Section** Jet Propulsion Laboratory, May - October 2019

W-Band landing radar raw data simulation - I wrote the simulator in Julia. Different modules had been implemented and tested to construct the simulator. The code runs on a distributed system.

**R&D FX and Simulation Intern** DreamWorks Animation, May - December 2018

Resolving contact problem in the hair simulation - I was working on a problem that was in the in-house hair simulator in which the hair elements pass through obstacles causing problem for the hair animators.

**Software developer Intern** Infinite Campus, Inc, June - December 2015

Software improvement - I transferred a piece of code from Ruby to Groovy to match with the rest of pipeline.

**PUBLICATIONS** Forootaninia, Zahra, and Rahul Narain. "Frequency-domain smoke guiding." ACM Transactions on Graphics (TOG) 39.6 (2020): 1-10.

Forootaninia, Zahra, Ioannis Karamouzas, and Rahul Narain. "Uncertainty Models for TTC-Based Collision-Avoidance." Robotics: Science and Systems. Vol. 7. 2017.

Srinivasan Karthik, Majurec Ninoslav, Ahmed Razi, Prager Samuel, Forootaninia Zahra, Mao Peter, Joshil Shashank Srinivas, Tope Michael. "Terminal Descent Radar System Testbed for Future Planetary Landers." IEEE Aerospace Conference March 2021.

Brown, George E., Matthew Overby, Zahra Forootaninia, and Rahul Narain. "Accurate dissipative forces in optimization integrators." ACM Transactions on Graphics (TOG) 37, no. 6 (2018): 1-14.

## SKILLS

**Technical:** Fluid simulation, Generative/GAN-based modeling, Crowd simulation, Quaternion based system, Geometric algebra, Physics Based Rendering Techniques (PBRT), SPH simulation, Ray casting, Image processing, Statistical analysis, Mathematical modeling.

**High Level Languages:** C++, Python, Julia, MATLAB

**Operating System:** Unix/Linux, Mac OS X, Windows

## TEACHING EXPERIENCE

**Algorithms and data Structure (CSci 4041)**, University of Minnesota –Teaching discussion sections, grading assignments and exams.

**Elementary Computational Linear Algebra (CSci 2033)**, University of Minnesota –Teaching discussion sections, grading assignments and exams.

**Introduction to Astronomy Labs (AST 1001)**, University of Minnesota –Teaching six labs, grading student projects, exams and lab reports.

## EDUCATION

**PhD Computer Science** 2016 - June 2022(expected), University of Minnesota, Minneapolis, MN - Thesis title: Guiding simulations of highly dynamic phenomena

**M.Sc. Astrophysics** 2012-2015, University of Minnesota, Minneapolis, MN

**B.Sc. Physics, Solid State Physics** 2007 - 2010, Yasouj University, Yasouj, Iran

## RELATED COURSES

Advanced Algorithm and Data Structure (CSCI 5421)

Computation Aspect of Matrix Theory (CSCI 5304)

Physics Based Animation (CSCI 8980)

Statistical Analysis (STAT 5021)

Fundamentals of Computer Graphics I / II (CSCI 5607 / CSCI 5608)

Computer Vision (CSCI 5561)

Astrophysical Radiative Processes (AST 8001)

Astrophysical Fluid Dynamics (AST 8031)

**Class projects:** Smooth Particle Hydrodynamics (SPH) solver, Ray-Tracing Engine, quaternion-based skeletal animation, shape detection

## AWARDS

**GAANN Fellowship** Graduate Assistance in Areas of National Need. University of Minnesota 2017-2018.

Dedicated teaching assistant award. University of Minnesota. Fall 2021.