CHRISTOPHER ILIFFE SPRAGUE

Researcher in structured artificial intelligence

sprague@kth.se | +46 (0) 730 807 541 | Stockholm, Sweden | USA | UK | Sweden
cisprague.github.io | cisprague | cisprague | cisprague | cisprague

EXPERIENCE

Researcher

Science for Life Laboratory

Jun 2022 – Present | Stockholm, SE

- Researching inductive bias for ML-based prediction of molecular interactions (adv. Hossein Azizpour & Arne Elofsson).
- Benchmarked ML-based docking models on apo and holo receptor structure variations (PDBBind + AlphaFold structures).
- Benchmarked ML-based docking models on decoys (DUDE-Z structures) for drug screening.
- Applied control-theory principles to generative models to reflect the physical stability of samples (e.g. molecular configurations).
- Supervising a PhD student in ML-based molecular interaction.
- Held lectures and created assignments on diffusion models for MS and PhD students.
- Advising postdocs in physical chemistry on ML-based prediction of perovskite solar cell recycling processes.

Researcher

KTH Royal Institute of Technology | Robotics, Perception, and Learning Department

Dec 2017 – Jun 2022 | Stockholm, SE

- Published research (100+ citations) in the intersections of control theory, machine learning, perception, and planning (adv. Petter Ögren and John Folkesson).
- Developed planning and computer vision algorithms for multiple AUV scenarios in ROS, collaborated with a team of researchers to integrate them with other subsystems (e.g. control, perception, localisation), and tested them in simulation and real life.
- Led workshops and presented research at conferences and seminars.
- Presented robotic demonstrations to industrial and governmental stakeholders of the Swedish Maritime Robotics Centre.
- Supervised multiple M.Sc. students to the completion of their theses.
- Developed and presented robotic planning assignments in a course of 200+ students over 4 semesters.
- Led help sessions in robotics and machine learning courses.
- Amplified research visibility with media outreach and social media.

AUV Assistant

University of Tasmania | Institute for Marine and Antarctic Studies

Dec 2019 – Feb 2020 | Amundsen Sea, West Antarctica

- Helped deploy the Nupiri Muka AUV near Thwaites glacier for under-ice data collection during the Korean Polar Research Institute's Winter 2019-2020 Antarctic expedition (adv. Peter King).

Researcher

European Space Agency | Advanced Concepts Team

Sep 2017 – Nov 2017 | Noordwijk aan Zee, NL

- Published research in the intersection of spacecraft trajectory optimisation and machine learning (adv. Dario Izzo).

SKILLS

Software

JAX | Flax | PyTorch | SymPy | Python | Mathematica | ROS

Machine Learning

Diffusion & Flow Matching | Physics-Informed Learning | Geometric Deep Learning | Reinforcement Learning

Mathematics

Stochastic Differential Equations | Optimal Control | Stability theory | Hybrid Dynamical Systems | Order Theory | Graph Theory | Hamiltonian Systems

EDUCATION

Ph.D. in Computer Science

KTH Royal Institute of Technology

Dec 2017 – Jun 2022

M.S. in Aerospace Engineering

Magna Cum Laude

Rensselaer Polytechnic Institute

May 2016 – May 2017

B.S. in Aerospace Engineering

Cum Laude

Rensselaer Polytechnic Institute

Aug 2013 – May 2016

LANGUAGES

English
Swedish
Spanish

Researcher

Japan Aerospace Exploration Agency | Institute of Space and Astronautical Science

Jun 2017 – Aug 2017 | Sagamihara, JP

- Researched machine learning for trajectory optimisation in the context of the lunar spacecraft mission EQUULEUS (adv. Yasuhiro Kawakatsu).
- Awarded East Asia and Pacific Summer Institute Fellowship ($5,400) by the National Science Foundation and Summer Fellowship (¥692,500) by the Japan Society for the Promotion of Science.

Learning Assistant

Rensselaer Polytechnic Institute

Aug 2016 – May 2017 | Troy, NY, USA

- Held consultation sessions and created a variety of workshops for study skills, time management, and stress management in order to promote academic excellence and encourage student involvement.

Software Engineering Intern

National Aeronautics and Space Administration

Jun 2015 – Aug 2015 | Laurel, MD, USA

- Produced targeted enhancements to the fault-protection systems of NASA's Solar Terrestrial Relations Observatory (adv. Dan Wilson and Kevin Balon).
- Updated the spacecrafts' testbeds to emulate their current operational modes.
- Awarded NASA Johns Hopkins Applied Physics Laboratory Fellowship ($4,000) by The Henry Foundation Inc.

SELECTED PUBLICATIONS

- **Sprague, Christopher I.**, Elofsson, A., & Azizpour, H. (2024). Stable autonomous flow matching. *In submission*.
- **Sprague, Christopher I.**, & Ögren, P. (2023). An extended convergence result for behaviour tree controllers. *In submission*.
- **Sprague, Christopher I.**, & Ögren, P. (2022). Adding neural network controllers to behavior trees without destroying performance guarantees. In *2022 ieee 61st conference on decision and control (cdc)* (pp. 3989–3996). doi:10.1109/CDC51059.2022.9992501
- **Sprague, Christopher I.**, & Ögren, P. (2021). Continuous-time behavior trees as discontinuous dynamical systems. *IEEE Control Systems Letters*.
- **Sprague, Christopher I.**, Izzo, D., & Ögren, P. (2020). Learning dynamic-objective policies from a class of optimal trajectories. In *2020 59th ieee conference on decision and control (cdc)* (pp. 597–602). IEEE.
- **Torroba, Ignacio***, **Sprague, Christopher I.***, Bore, N., & Folkesson, J. (2020). Pointnetkl: Deep inference for gicp covariance estimation in bathymetric slam. *IEEE Robotics and Automation Letters*, *5*(3), 4078–4085. ***Equal contribution**.
- Izzo, D., **Sprague, Christopher I.**, & Tailor, D. V. (2019). Machine learning and evolutionary techniques in interplanetary trajectory design. In G. Fasano & J. D. Pintér (Eds.), *Modeling and optimization in space engineering : State of the art and new challenges* (pp. 191–210). doi:10.1007/978-3-030-10501-3_8
- **Sprague, Christopher I.**, Özkahraman, Ö., Munafo, A., Marlow, R., Phillips, A., & Ögren, P. (2018). Improving the modularity of auv control systems using behaviour trees. In *2018 ieee/oes autonomous underwater vehicle workshop (auv)* (pp. 1–6). IEEE.

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Prof. Hossein Azizpour
@ KTH Royal Institute of Technology
azizpour@kth.se

Prof. Arne Elofsson
@ Science for Life Laboratory
arne@bioinfo.se

Prof. Petter Ögren
@ KTH Royal Institute of Technology
petter@kth.se

Prof. John Folkesson
@ KTH Royal Institute of Technology
johnf@kth.se

Alberto Fernandez, PhD
@ KTH Royal Institute of Technology
alberto3@kth.se

PRESS (HYPERLINKED)

- SMaRC-team shares knowledge and encourages international collaboration at Breaking the Surface (Oct 20, 2021)
- Researchers celebrate Antarctic under ice voyages of underwater vehicle (Mar 18, 2020, IMAS UTAS)
- KTH doctoral students examined shipwrecks from the 16th century (Sep 16, 2019, KTH)
- A Shipwreck, 500 Years Old, Appears on the Baltic Seabed (Jul 22, 2019, New York Times)
- Using behavior trees to improve the modularity of AUV control systems (Nov 12, 2018, Tech Xplore)
- Rensselaer Graduate Students Successful in Garnering Summer Fellowships (Feb 28, 2017, RPI)

ADDITIONAL INFO

Interests

Middle-distance running | Cycling | Weightlifting | Nutrition | Hiking | Neuroscience | Psychology | Sustainability | Travelling

Volunteering

Olio Food Waste Hero