

Arnold Kalmbach

Data scientist specializing in machine learning, computer vision, and DSP. Extensive experience implementing high quality research code with the scientific Python stack.

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Education

McGill University — MSc. Computer Science

Jan 2016 — Sep 2018

Thesis - *Unsupervised Learning of Interpretable Models for Sparse, Smooth Data* (Sep. 2018). Contributed a variety of Bayesian non-parametric methods to learn temporally varying semantic maps.

Significant work on machine learning, computer vision, and algorithmic robotics problems as well as robot deployments and field experiments.

Coursework focus on fundamentals of machine learning, computer vision, digital signal processing, and optimization.

Supervisor Greg Dudek, Mobile Robotics Lab

Achieved 3.88/4.0 GPA

McGill University — BSc. Comp. Sci.

Sep 2009 - May 2013

Emphasis on mathematical foundations of Comp. Sci.

Began involvement with robotics research, Mobile Robotics Lab (2012).

Honors and Awards

2nd place, Student Poster Competition, MTS Oceans 2017

2017 ICRA IEEE RAS Travel Grant Recipient

Guest Student Appointment, Summer 2016, Woods Hole Oceanographic Institution

3rd place, McGill CS Undergraduate Research Symposium 2012

Selected Work Experience

Data Scientist — Kinsol Research Inc.

Sep 2018 — Present

Implemented machine learning, computer vision, and signal processing algorithms for a broad range of client projects.

Provided insight into relevant algorithms, and rapid prototype implementations of the most appropriate options given project constraints.

Analysed, tuned, and provided regular quantitative evaluation of algorithms, ensuring products continuously improve and remain reliable in the real world.

Projects included fingernail tracking and detection from video, parking lot fill state estimation, real-time instrument, chord, and key detection in music, low-latency vocal pitch shifting etc.

Data Scientist (Part Time) - Kinsol Research Inc.

May 2017 — Sep 2018

Developed food 'doneness', burnt, and smoke detection models for a low-cost vision system in a smart oven.

Worked with the client to iteratively develop the method and the dataset together to fulfill the client's user story within the constraints of their ability to label data.

Teaching Assistant, Introduction to Robotics and Intelligent Systems -

Jan - May 2017

McGill University, School of Computer Science, COMP 417

Automated Video Analysis Intern — Ocean Networks Canada

Jun — Nov 2015

Implemented an algorithm to automatically produce sea-floor classification maps from dive-log videos (Kalmbach, WACV 2016 in Publications section).

Implemented and deployed algorithms for automated quality control (prediction of failing camera deployments etc.) of live deep-sea video.

Deployed supporting tools to automatically download, encode, and pre-process live video streams from a network of underwater observatories.

Test Technician (Contract) – Clearpath Robotics Inc.

Jan - May 2015

Tools automatically initiate a Gazebo simulation of Husky robot autonomy tasks on every new commit to the Husky autonomy code repository.

Developed continuous integration tools for Clearpath robot autonomy software stack. Tasks exercised a variety of robot autonomy behaviours such as localization, mapping and waypoint-based path following.

The tool resulted in a significant increase in reliability of the husky autonomy stack, and is used as a template for autonomy testing for other safety-critical applications at Clearpath.

Autonomy Software Co-Op – Clearpath Robotics Inc.

May – Aug 2014

Developed Gazebo models, and MoveIt / MoveBase (ROS path planner) integration for a variety of customized client robots.

Used canopen protocol and pcan drivers to integrate an industrial robot arm with a Husky terrestrial rover.

Publications & Research Experience

Learning Seasonal Phytoplankton Communities with Topic Models.

MTS OCEANS 2017

A Kalmbach, H M Sosik, G Dudek, and Y Girdhar

An unsupervised method to learn probabilistic associations between species (communities) with a topic model, incorporating priors for sparseness and spatio-temporal smoothness.

The method finds an interpretable community model by ensuring community distributions can be predicted from simple environment data.

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Phytoplankton Hotspot Prediction with an Unsupervised Spatial Community Model. **A Kalmbach, Y Girdhar, H M Sosik and G Dudek.**

ICRA 2017

A method to predict presence of sparse spatio-temporal phenomena by their denser associates.

The method predicts the ‘hotspot locations’ of phytoplankton species by the abundance of other species which may be easier to observe.

Learning Deep-Sea Substrate Types with Visual Topic Models.

WACV 2016

A Kalmbach, M Hoeberechts and A Branzan Albu

Unsupervised learning of distribution-of-visual-features representations for sea-floor types from ROV dive logs.

Sea-floor classifications were used in further bio-geophysical studies of the study sight.

Adaptive Parameter EXploration (APEX): Adaptation of Robot Autonomy from Human Participation. **A Xu, A Kalmbach, and G Dudek.**

ICRA 2014

Formulation and implementation of a robot system which models human trust levels and adapts its behavior to gain trust and increase user satisfaction.

Designed, implemented, and evaluated user-studies with a (real) terrestrial rover and a simulated aerial vehicle.

Assymmetric Rendezvous at Sea **M. Meghjani, F Shkurti, JC Gamboa Higuera, A Kalmbach, D Whitney, and G Dudek.**

CRV 2014

Investigated strategies for an active searcher to find a passive drifter at sea.

Implemented UDP-based communications between an AUV and a floating sensor box.

Unsupervised environment recognition and modeling using sound sensing.

ICRA 2013

A Kalmbach, Y Girdhar, and G Dudek

Unsupervised learning of distribution-of-audio-features representations for ambient noise from walking through urban environments.

Similarity in the learned topic space indicates intuitively similar environments and can be used for soft loop-closure.

AQUA Robot Hardware Test Tools

IROS 2012

Developed a suite of hardware diagnostic tools for AQUA family amphibious robots.

Similarity in the learned topic space indicates intuitively similar environments and can be used for soft loop-closure.

Tools were used in 2012 Barbados sea-trials, leading to F. Shkurti et al. *Multi-domain monitoring of marine environments using a heterogeneous robot team*.

Languages & Other Skills

Main Programming Languages	Python (numpy/scipy/pytorch/tensorflow etc), C, C++ Can quickly spin back up in many others.
Development and cloud tools	Docker, git, AWS stack (EC2, S3, RDS)
Robotics Tools	Extensive use of ROS, Gazebo, OpenCV
Linux Audio	JUCE framework, jack, Bitwig Studio
Spoken Languages	First language, English. Basic conversational level: French and Spanish.