

# Kristof Richmond

Miami, FL  
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## Education

- 2001–2009 **Ph.D., Mechanical Engineering**, *Stanford University*, Stanford, CA.  
2000–2001 **M.S., Mechanical Engineering**, *Stanford University*, Stanford, CA.  
1993–1997 **B.S. Mechanical Engineering, cum laude**, *Rice University*, Houston, TX.  
**B.A., German, cum laude**, *Rice University*, Houston, TX.

## Dissertation

### ***Real-time Visual Mosaicking and Navigation on the Seafloor.***

Presents a system for visually-aided navigation of underwater robotic vehicles in unexplored areas of the seafloor, using only instruments on board the vehicle (inertial, acoustic doppler, cameras, pressure-depth), and an operational implementation fielded on deployed robotic vehicles.

Readers: Stephen Rock (adviser), Christian Gerdes, Claire Tomlin

## Experience

- 2014–present **Projects Manager**, *Stone Aerospace, Inc.*  
Austin, TX  
Developing, proposing, and realizing new concepts in through-ice and underwater robotic vehicles, including:
- *SUNFISH AUV*: Software team manager for a human-portable hovering autonomous underwater vehicle for 3D mapping, autonomous exploration, inspection, and life search in complex and unstructured environments.
  - *ARCHIMEDES* (2-year NASA ColdTECH grant): Project manager for twelve-person design, fabrication, and test team on an effort to design a Direct Laser Penetration (DLP) ice probe and cryogenic vacuum chamber to validate a new breakthrough concept in rapid ice penetration in vacuum as well as remote, fiber-based sensing for deployment on extraterrestrial icy worlds.
  - *SPINDLE Phase A1* (1.5-year NASA grant): Project manager for fifteen-person design team on a trade study and lab test effort to design an ice-penetrating cryobot carrying a small autonomous underwater vehicle to explore sub-glacial lakes and oceans analogous to extraterrestrial icy worlds.
  - *ARTEMIS AUV* (part of SIMPLE, a 4-year NASA ASTEP grant): Lead engineer of twelve-person design team and six-person software team, for an ocean-going under-ice autonomous vehicle to map out and sample a portion of the Ross Ice Shelf in Antarctica. Also performed system design, navigation and control system development tasks, and participated in two-month field deployment.
- 2007–present **Lead GNC Engineer and Partner**, *Frontier Astronautics, LLC.*  
Chugwater, WY  
Management, design, and development for airborne and underwater robotic vehicle projects including:
- *Viper MkII*: Planning, design, and prototype manufacture of novel low-cost, highly-throttleable, reusable rocket engine targeted at the entrepreneurial space industry.
  - *Underwater visual navigation*, for *Zupt, LLC*: Developed visual navigation systems for underwater robotic vehicles.
  - *VALKYRIE cryobot*, for *Stone Aerospace* (4-year NASA ASTEP grant): Designed navigation and control hardware and software for navigation and obstacle avoidance of a maneuverable ice melt-probe deployed in Alaskan glaciers.

- *ENDURANCE AUV*, for *Stone Aerospace* (3-year NASA ASTEP grant): Designed updated navigation and control combining inertial, doppler, and acoustic systems for under-ice operations of an autonomous underwater vehicle which guaranteed return of the vehicle to a deployment melt hole. Participated in two field team deployments with the vehicle to Lake Bonney, Antarctica.
  - *Real-time tracking*, for *Sensing Systems*: Developed prototype real-time visual tracking and real-time mosaicking systems for implementation in data management system streams.
  - *Laramie Rose*, for *SpeedUp, LLC*: Developed and deployed control system based on low-cost inertial and GPS sensors for XPrize Lunar Lander Challenge hovering rocket-powered vehicle.
- 2001–2007 **Research Assistant**, *Stanford University*.  
Stanford, CA  
Aerospace Robotics Lab, Department of Aeronautics and Astronautics.
- Developed low-level real-time communications, vision, and driver component library and software employed in multiple laboratory and field robotics research projects.
  - Developed and deployed novel sea floor mapping, navigation and control system for routine use with remotely operated underwater vehicles of the Monterey Bay Aquarium Research Institute.
- Spring, 2002 **Teaching Assistant**, *Stanford University*.  
Stanford, CA  
Assisted Prof. Sanjay Lall with ENGR207b: Modern Control.
- 1997–2000 **Technician**, *SRI International, Sondrestrom Atmospheric Research Facility*.  
Kangerlussuaq, Greenland
- Responsible with three other site crew members for operations, maintenance, and repairs of one-of-a-kind scientific instruments and other facility equipment at remote research station.
  - Developed and implemented precision steering control system for 32-m scientific radar antenna as part of general facility upgrade.

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## Publications

Publication reprints are available at [http://kristofrichmond.net/Kristof\\_Richmond/Publications.html](http://kristofrichmond.net/Kristof_Richmond/Publications.html).

### Journal Publications

Peter W. Kimball, Evan B. Clark, Mark Scully, **Kristof Richmond**, Chris Flesher, Laura Lindzey, John Harman, Keith Huffstutler, Justin Lawrence, Scott Lelievre, Joshua Moor, Brian Pease, Vickie Siegel, Luke Winslow, Don Blankenship, Peter Doran, Stacy Kim, Britney Schmidt, William C. Stone. “The ARTEMIS Under-Ice AUV Docking System.” *Journal of Field Robotics*, *forthcoming*.

William C. Stone, Bartholomew P. Hogan, Christopher Flesher, Shilpa Gulati, **Kristof Richmond**, Aniket Murarka, Greg Kuhlman, Mohan Sridharan, Victoria Siegel, Rachel Price and Peter T. Doran, and John Priscu. “Design and deployment of a four-degrees-of-freedom hovering autonomous underwater vehicle for sub-ice exploration and mapping.” *Journal of Engineering for the Maritime Environment*, 224(M4):341–361, 2010.

### Book Chapters

William C. Stone, **Kristof Richmond**, Christopher Flesher, Bart Hogan, and Vickie Siegel. “Sub-Ice Autonomous Underwater Vehicle Architectures for Ocean World Exploration and Life Search.” *Ocean Worlds Technology*. Springer Verlag, *forthcoming*.

## Refereed Conference Publications

Shilpa Gulati, **Kristof Richmond**, Christopher Flesher, Bartholomew P. Hogan, Aniket Murarka, Gregory Kuhlmann, Mohan Sridharan, William C. Stone, and Peter T. Doran. "Toward autonomous scientific exploration of ice-covered lakes—field experiments with the ENDURANCE AUV in an Antarctic dry valley." In *Proceedings of the 2010 IEEE International Conference on Robotics and Automation (ICRA)*, pp. 308–315, Anchorage, Alaska, May 3–7 2010.

## Conference Proceedings

Alessandro Febretti, **Kristof Richmond**, Shilpa Gulati, Christopher Flesher, Bartholomew P. Hogan, Andrew Johnson, William C. Stone, John Priscu, Peter Doran. "Poisson reconstruction of extreme submersed environments: The ENDURANCE exploration of an under-ice Antarctic lake." In *Proceedings of the 8th International Symposium on Visual Computing (ISVC '12)*, Crete, Greece, July 16–18 2012.

**Kristof Richmond**, Alessandro Febretti, Shilpa Gulati, Christopher Flesher, Bartholomew P. Hogan, Aniket Murarka, Greg Kuhlmann, Mohan Sridharan, Andrew Johnson, William C. Stone, John Priscu, Peter Doran. "Sub-ice exploration of an Antarctic lake: results from the ENDURANCE project." In *Proceedings of the Unmanned Untethered Submersible Technology Conference (UUST)*, Durham, New Hampshire, August 21–23 2011. AUSI.

**Kristof Richmond**, Shilpa Gulati, Christopher Flesher, Bartholomew P. Hogan, and William C. Stone. "Navigation, control, and recovery of the ENDURANCE under-ice hovering AUV." In *Proceedings of the Unmanned Untethered Submersible Technology Conference (UUST)*, Durham, New Hampshire, August 24–26 2009. AUSI.

William C. Stone, Bartholomew Hogan, Christopher Flesher, Shilpa Gulati, **Kristof Richmond**, Aniket Murarka, Greg Kuhlman, Mohan Sridharan, Peter Doran, and John Priscu. "Sub-ice exploration of West Lake Bonney: ENDURANCE 2008 mission." In *Proceedings of the Unmanned Untethered Submersible Technology Conference (UUST)*, Durham, New Hampshire, August 24–26 2009. AUSI.

**Kristof Richmond** and Stephen Rock. "Real-time visual mosaicking and navigation of the USS Macon." In *Proceedings of the Unmanned Untethered Submersible Technology Conference (UUST)*, Durham, New Hampshire, August 2007. AUSI.

**Kristof Richmond** and Stephen Rock. "An operational real-time large-scale visual mosaicking and navigation system." In *Proceedings of the MTS/IEEE OCEANS Conference*, Boston, September 2006. IEEE.

**Kristof Richmond** and Stephen Rock. "A real-time visual mosaicking and navigation system." In *Proceedings of the Unmanned Untethered Submersible Technology Conference (UUST)*, Durham, New Hampshire, August 2005. AUSI.

**Kristof Richmond**, David Black-Schaffer and Stephen Rock. "Automatic determination of vision lock on the seafloor in the presence of dust." In *Proceedings of the Unmanned Untethered Submersible Technology Conference (UUST)*, Durham, New Hampshire, August 2003. AUSI.

## Conference Posters and Presentations

**Kristof Richmond**, William C. Stone, Evan B. Clark, Christopher Flesher, Laura Lindzey, John Harman, Keith Huffstutler, Justin Lawrence, Scott Lelievre, Josh Moor, Brian Pease, Mark Scully, Vickie Siegel, Luke Winslow, Don Blankenship, Peter Doran, Stacey Kim, and Britney Schmidt. "ARTEMIS: Deployment of a long-range hovering robotic vehicle for rich data acquisition and sample return beneath the Ross Ice Shelf." In *Astrobiology Science Conference (AbSciCon)*, Mesa, Arizona, April 2017.

Peter W. Kimball, William C. Stone, Bartholomew P. Hogan, **Kristof Richmond**, Christopher Flesher, Victoria L. Siegel, Scott LeLievre, Evan B. Clark, John Harman, Keith Huffstutler, Laura Lindzey, Mark Scully, Peter Doran, Mark Skidmore, Stacey Kim, Britney Schmidt. "ARTEMIS: Long-range ice-contacting robotic vehicle for rich data acquisition and sample return beneath the Ross Ice Shelf." In *Astrobiology Science Conference (AbSciCon)*, Chicago, Illinois, June 2015.

### Other Publications

**Kristof Richmond** and Stephen Rock. "An operational real-time, large-scale visual mosaicking and navigation system." *Sea Technology*, 48(3):10–13, March 2007.

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### Invited Talks

Exploration of Ice-Covered Lakes: Experiments with the ENDURANCE AUV in Antarctica's Dry Valleys. Seminar, Department of Mechanical Engineering, Tufts University, Medford, Massachusetts, Feb. 2010.

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### Professional Activities

Session Chair: Astrobiology Science Conference 2017.

Referee: IEEE Journal of Ocean Engineering; International Conference on Robotics and Automation; NAVIGATION: Journal of the Institute of Navigation; Annals of Glaciology.

Translator, from German: Klaus Janschek. *Mechatronic Systems Design*. Springer-Verlag, 2011.

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### Professional Memberships

Member, Tau Beta Pi, The National Engineering Honor Society.

Senior Member, Institute of Electrical and Electronic Engineers (IEEE).

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### Media Appearances

Daniel Oberhaus. An Alien-Hunting Submarine Is Being Tested in Antarctica. *Vice Motherboard*, 7 May 2017.

Drama am Himmel – die Geschichte der Fliegenden Flugzeugträger. *Spiegel-TV*, 10 Jul. 2010.

Journey to an Alien Moon. *National Geographic Explorer*, 20 Apr. 2010.

Flying Aircraft Carrier. *National Geographic Channel*, 9 Feb. 2009.

John J. Geoghegan III. Return to USS Macon. *Aviation History*, May 2007, pp. 32–43.

John J. Geoghegan III. Studying a Navy Relic, Undisturbed for Nearly 60 Years. *The New York Times*, 3 Oct. 2006.

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### Community Involvement

2003–present

**Engineers for a Sustainable World**, *Past Secretary, Vice President, and President, Stanford Chapter; Professional Member.*

Student organization researching, developing and implementing sustainable engineering solutions to problems facing developing communities around the world. As an inaugural member of executive board of Stanford Chapter, oversaw organization of chapter activities including student-led classes, national conference, and projects on campus and abroad (Kenya, India, Haiti, Nepal).

2003–2015

**Friends of Anatolia**, *Co-founder and Secretary.*

Non-profit organization promoting cultural and development ties between the US and Turkey.

- 2008–2013 **Friends of the Animal Center Foundation**, *Treasurer*.  
Foundation supporting medical care and training to improve the lives of homeless animals at the Iowa City Animal Care and Adoption Center. Oversaw financial operation of foundation including a \$1 million capital campaign.
- 2003–2007 **Stanford Young Astronauts**, *Mentor and Program Coordinator*.  
Student organization teaching local 3rd and 4th graders the basics of science and engineering in monthly sessions.