Stanford

Stephen Rock

Professor of Aeronautics and Astronautics, Emeritus

CONTACT INFORMATION

- **Administrator**

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Bio

BIO

Professor Rock's research interests include the application of advanced control and modeling techniques for robotic and vehicle systems (aerospace and underwater). He directs the Aerospace Robotics Laboratory in which students are involved in experimental programs designed to extend the state-of-the-art in robotic control. Areas of emphasis include planning and navigation techniques (GPS and vision-based) for autonomous vehicles; aerodynamic modeling and control for aggressive flight systems; underwater remotely-operated vehicle control; precision end-point control of manipulators in the presence of flexibility and uncertainty; and cooperative control of multiple manipulators and multiple robots. Professor Rock teaches several courses in dynamics and control.

ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Aeronautics and Astronautics
- Member, Bio-X

PROFESSIONAL EDUCATION

- PhD, Stanford University (1978)

Teaching

COURSES

2023-24

- Introduction to Control Design Techniques: ENGR 205 (Aut)

Publications

PUBLICATIONS

- **A hybrid underwater robot for multidisciplinary investigation of the ocean twilight zone.** *Science robotics*
  Yoerger, D. R., Govindarajan, A. F., Howland, J. C., Llopiz, J. K., Wiebe, P. H., Curran, M., Fujii, J., Gomez-Ibanez, D., Katija, K., Robison, B. H., Hobson, B. W., Risi, M., Rock, et al

2021; 6 (55)

- **A Pilot Aid for Real-Time Vision-Based Coverage Estimation for Seabed Surveying Applications**
  Mahajan, A., Rock, S., IEEE
  IEEE.2020
- **Mesobot: An Autonomous Underwater Vehicle for Tracking and Sampling Midwater Targets**
  Yoerger, D. R., Curran, M., Fujii, J., German, C. R., Gomez-Ibanez, D., Govindarajan, A. F., Howland, J. C., Llopiz, J. K., Wiebe, P. H., Hobson, B. W., Katija, K., Risi, M., Robison, et al
  IEEE.2018
- **Iceberg Wall Following and Obstacle Avoidance by an AUV**
  McEwen, R. S., Rock, S. P., Hobson, B., IEEE
  IEEE.2018
- **Online attitude determination of a passively magnetically stabilized spacecraft** *ACTA ASTRONAUTICA*
  Burton, R., Rock, S., Springmann, J., Cutler, J.
  2017; 133: 269-281
- **Mapping of Translating, Rotating Icebergs With an Autonomous Underwater Vehicle** *IEEE JOURNAL OF OCEANIC ENGINEERING*
  Kimball, P. W., Rock, S. M.
  2015; 40 (1): 196-208
- **Dual attitude and parameter estimation of passively magnetically stabilized nano satellites** *Acta Astronautica*
  Burton, R., Rock, S., M., Springmann, J., Cutler, J.
  2014; 94 (1): 145 - 158
- **Correlation of Sidescan Sonar Acoustic Shadows and Bathymetry for Terrain-Relative Navigation** *Unmanned Untethered Submersible Technology*
  Padial, J., Dektor, S., G., Rock, S., M.
  2013
- **Guidance Augmentation for Reducing Uncertainty in Vision-Based Hazard Mapping during Lunar Landing** *IEEE Aerospace, IEEE*
  Crane, E., S., Rock, S., M.
  2013
- **A Robust Framework for Failure Detection and Recovery for Terrain-Relative Navigation** *Unmanned Untethered Submersible Technology*
  Houts, S., E., Dektor, S., G., Rock, S., M.
  2013
- **Online Attitude Determination of a Passively Magnetically Stabilized Spacecraft**
  Burton, R., Rock, S., M., Springmann, J., Cutler, J.
  2013
- **Improving Robustness of Terrain-Relative Navigation for AUVs in Regions with Flat Terrain** *IEEE/OES Autonomous Underwater Vehicles Conference (AUV)*
  Dektor, S., Rock, S.
  IEEE.2012
- **Influence of Trajectory on Accuracy of Hazard Estimation During Lunar Landing**
  Crane, E., S., Rock, S., M.
  2012
- **Dual Attitude and Parameter Estimation of Passively Magnetically Stabilized Spacecraft**
  Burton, R., Rock, S., M., Springmann, J., Cutler, J.
  2012
- **Tumbling Target Reconstruction and Pose Estimation through Fusion of Monocular Vision and Sparse-Pattern Range Data** *IEEE MFI*
  Padial, J., Hammond, M., Augenstein, S., Rock, S., M.
  2012

- **A NEW METHOD FOR SIMULATING THE ATTITUDE DYNAMICS OF PASSIVELY MAGNETICALLY STABILIZED SPACECRAFT** *22nd AAS/AIAA Space Flight Mechanics Meeting*
  Burton, R., Starek, J., Rock, S.
  UNIVELT INC.2012: 967–980
- **Aggressive Terrain Following for Motion-constrained AUVs** *IEEE/OES Autonomous Underwater Vehicles Conference (AUV)*
  Houts, S. E., Rock, S. M., McEwen, R.
  IEEE.2012
- **Sonar-based iceberg-relative navigation for autonomous underwater vehicles** *DEEP-SEA RESEARCH PART II-TOPICAL STUDIES IN OCEANOGRAPHY*
  Kimball, P., Rock, S.
  2011; 58 (11-12): 1301-1310
- **Hybrid Estimation Using Perceptional Information: Robotic Tracking of Deep Ocean Animals** *IEEE JOURNAL OF OCEANIC ENGINEERING*
  Plotnik, A., Rock, S.
  2011; 36 (2): 298-315
- **Improved Frame-to-Frame Pose Tracking during Vision-Only SLAM/SFM with a Tumbling Target** *IEEE International Conference on Robotics and Automation (ICRA)*
  Augenstein, S., Rock, S. M.
  IEEE.2011
- **OPTIMAL DESPIN OF A TUMBLING SATELLITE WITH AN ARBITRARY THRUSTER CONFIGURATION, INERTIA MATRIX, AND COST FUNCTIONAL** *20th AAS/AIAA Spaceflight Mechanics Meeting*
  Sheinfeld, D., Rock, S.
  UNIVELT INC.2010: 637–647
- **Estimation of Iceberg Motion for Mapping by AUVs**
  Kimball, P., Rock, S., M.
  2010
- **Closed-Loop Terrain Relative Navigation for AUVs with Non-Inertial Grade Navigation Sensors**
  Meduna, D., Rock, S., M., McEwen, R.
  2010
- **Development of a Programmable Rotational Motion Laboratory Demonstrator**
  Russell, S., P., Rock, S., M.
  2010
- **Spline-based Trajectory Planning Techniques for Benthic AUV Operations**
  Murthy, K., Rock, S., M.
  2010
- **Feedback Dual Controller Design and Its Application to Monocular Vision-Based Docking** *AIAA Guidance, Navigation, and Control Conference*
  Kim, J., Rock, S.
  AMER INST AERONAUT ASTRONAUT.2009: 1134–42
- **RIGID BODY INERTIA ESTIMATION WITH APPLICATIONS TO THE CAPTURE OF A TUMBLING SATELLITE** *AAS/AIAA 19th Space Flight Mechanics Meeting*
  Sheinfeld, D., Rock, S.
  UNIVELT INC.2009: 343–356
- **Performing Visual Surveys of Non-Planar Benthic Terrain**
  Murthy, K., Rock, S., M.
  2009
- **Particle Filtering Range Data for Pose Estimation under Torque-Free Motion**
  Russell, S., P., Rock, S., M.
  2009

- **AUV/ROV Pose and Shape Estimation of Tethered Targets without Fiducials**
  Augenstein, S., Rock, S., M.
  2009
- **Sonar-Based Iceberg-Relative AUV Localization** *UUST: Unmanned Untethered Submersible Technology*
  Kimball, P., Rock, S., M.
  2009
- **Simultaneous Estimation of Target Pose and 3-D Shape using the FastSLAM Algorithm**
  Augenstein, S., Rock, S., M.
  2009
- **Navigation for Performing Visual Surveys of Non-Planar Surfaces**
  Murthy, K., Rock, S., M.
  2009
- **AUV Terrain Relative Navigation Using Coarse Maps**
  Meduna, D., Rock, S., M., McEwen, R.
  2009
- **Control of a climbing robot using real-time convex optimization** *4th IFAC Symposium on Mechatronic Systems*
  Miller, T. G., Rock, S.
  PERGAMON-ELSEVIER SCIENCE LTD.2008: 301–13
- **Low-Cost Terrain Relative Navigation for Long-Range AUVs** *OCEANS 2008 Conference*
  Meduna, D. K., Rock, S. M., McEwen, R.
  IEEE.2008: 1643–1649
- **Estimating Inertial Position and Current in the Midwater** *OCEANS 2008 Conference*
  Augenstein, S., Rock, S.
  IEEE.2008: 1738–1743
- **Sonar-Based Iceberg-Relative AUV Navigation** *IEEE/OES Autonomous Underwater Vehicles Conference (AUV 2008)*
  Kimball, P., Rock, S.
  IEEE.2008: 20–25
- **Automatic ROV positioning services tethered ocean moorings - ROV is hovered automatically with respect to moving moored platform, while single pilot performs servicing tasks** *SEA TECHNOLOGY*
  Plotnik, A. M., Rock, S. M.
  2007; 48 (4): 50-54
- **An operational real-time large-scale visual mosaicking and navigation system - Precision benthic positioning and mapping without transponders** *SEA TECHNOLOGY*
  Richmond, K., Rock, S.
  2007; 48 (3): 10-13
- **Improved estimation of target velocity using multiple model estimation and a dynamic Bayesian network for a robotic tracker of ocean animals** *12th International Symposium on Robotics Research (ISRR)*
  Plotnik, A., Rock, S.
  SPRINGER-VERLAG BERLIN.2007: 402–415
- **Real-Time Visual Mosaicking and Navigation of the USS Macon**
  Richmond, K., Rock, S., M.
  2007
- **Design and validation of a robotic control law for observation of deep-ocean jellyfish** *IEEE TRANSACTIONS ON ROBOTICS*
  Rife, J. H., Rock, S. M.
  2006; 22 (2): 282-291
- **Visual servoing of an ROV for servicing of tethered ocean moorings** *Oceans 2006 Conference*

Plotnik, A. M., Rock, S. M.
IEEE.2006: 1451–1456

- **Stochastic Feedback Controller Design Considering the Dual Effect**
  Kim, J., Rock, S., M.
  2006
- **An operational real-time large-scale visual mosaicking and navigation system** *Oceans 2006 Conference*
  Richmond, K., Rock, S. M.
  IEEE.2006: 1245–1250
- **Free-climbing with a multi-use robot** *9th International Symposium on Experimental Robotics (ISER)*
  Bretl, T., Rock, S., Latombe, J. C., Kennedy, B., Aghazarian, H.
  SPRINGER-VERLAG BERLIN.2006: 449–458
- **Toward autonomous free-climbing robots** *11th International Symposium on Robotics Research*
  Bretl, T., Latombe, J. C., Rock, S.
  SPRINGER-VERLAG BERLIN.2005: 6–15
- **Relative Position Sensing and Automatic Control for Observation in the Midwater by an Underwater Vehicle**
  Plotnik, A., M., Rock, S., M.
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- **Multi-step motion planning for free-climbing robots** *6th International Workshop on Algorithmic Foundations of Robotics*
  Bretl, T., Lall, S., Latombe, J. C., Rock, S.
  SPRINGER-VERLAG BERLIN.2005: 59–74
- **A Multi-Sensor Approach to Automatic Tracking of Midwater Targets by an ROV**
  Plotnik, A., M., Rock, S., M.
  2005
- **Relative Position Sensing and Automatic Control for Observation in the Midwater by an Underwater Vehicle**
  Plotnik, A., M., Rock, S., M.
  2005
- **Multi-step motion planning for free-climbing robots** *6th International Workshop on Algorithmic Foundations of Robotics*
  Bretl, T., Lall, S., Latombe, J. C., Rock, S.
  SPRINGER-VERLAG BERLIN.2005: 59–74
- **Autonomous Deployment of a Self-Calibrating Pseudolite Array for Mars Rover Navigation**
  Matsuoka, M., Rock, S., M., Bualat, M., G.
  2004
- **Autonomous deployment of a self-calibrating pseudolite array for Mars rover navigation** *IEEE Position Location and Navigation Symposium*
  Matsuoka, M., Rock, S. M., Bualat, M. G.
  IEEE.2004: 733–739
- **Segmentation methods for visual tracking of deep-ocean jellyfish using a conventional camera** *IEEE JOURNAL OF OCEANIC ENGINEERING*
  Rife, J., Rock, S. M.
  2003; 28 (4): 595-608
- **Mars navigation system utilizes GPS** *IEEE AEROSPACE AND ELECTRONIC SYSTEMS MAGAZINE*
  LeMaster, E. A., Matsuoka, M., Rock, S. M.
  2003; 18 (4): 3-8
- **A local-area GPS pseudolite-based navigation system for Mars rovers** *10th International Conference on Advanced Robotics*
  LeMaster, E. A., Rock, S. M.
  SPRINGER.2003: 209–24

- **Motion planning for a three-limbed climbing robot in vertical natural terrain** *20th IEEE International Conference on Robotics and Automation (ICRA)*
  Bretl, T., Rock, S., Latombe, J. C.
  IEEE.2003: 2946–2953
- **An integrated system for command and control of cooperative robotic systems** *11th International Conference on Advanced Robotics (ICAR 2003)*
  Clark, C. M., Frew, E. W., Jones, H. L., Rock, S. M.
  UNIV COIMBRA, FAC CIENCIAS & TECHNOL.2003: 459–464
- **Trajectory generation for constant velocity target motion estimation using monocular vision** *20th IEEE International Conference on Robotics and Automation (ICRA)*
  Frew, E. W., Rock, S. M.
  IEEE.2003: 3479–3484
- **Relative position sensing by fusing monocular vision and inertial rate sensors** *11th International Conference on Advanced Robotics (ICAR 2003)*
  Huster, A., Rock, S. M.
  UNIV COIMBRA, FAC CIENCIAS & TECHNOL.2003: 1562–1567
- **Motion planning for multiple mobile robots using dynamic networks** *20th IEEE International Conference on Robotics and Automation (ICRA)*
  Clark, C. M., Rock, S. M., Latombe, J. C.
  IEEE.2003: 4222–4227
- **Improving Performance of a Jelly-Tracking Underwater Vehicle Using Recognition of Animal Motion Modes**
  Plotnik, A., M., Rock, S., M.
  2003
- **Dynamic Robot Networks for Motion Planning in Multi-Robot Space Systems**
  Clark, C., M., Rock, S., M., Latombe, J., C.
  2003
- **An Integrated System for Command and Control of Cooperative Robotic Systems**
  Clark, C., M., Frew, E., W., Jones, H., L., Rock, S., M.
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- **Relative Position Sensing by Fusing Monocular Vision and Inertial Rate Sensors**
  Huster, A., Rock, S., M.
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- **Trajectory Generation for Monocular-Vision Based Tracking of a Constant-Velocity Target**
  Frew, E., W., Rock, S., M.
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- **Climbing Robots in Natural Terrain**
  Bretl, T., Miller, T., Rock, S., M., Latombe, J., C.
  2003
- **Automatic Determination of Vision Lock on the Seafloor in the Presence of Dust**
  Richmond, K., Black-Schaffer, D., Rock, S., M.
  2003
- **Motion Planning for Multiple Mobile Robots using Dynamic Networks**
  Clark, C., M., Rock, S., M., Latombe, J., C.
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- **Gradient-based parameter optimization for systems containing discrete-valued functions** *INTERNATIONAL JOURNAL OF ROBUST AND NONLINEAR CONTROL*
  Wilson, E., Rock, S. M.
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- **Randomized kinodynamic motion planning with moving obstacles** *INTERNATIONAL JOURNAL OF ROBOTICS RESEARCH*
  Hsu, D., Kindel, R., Latombe, J. C., Rock, S.
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- **Dialogue-based human-robot interaction for space construction teams** *IEEE Aerospace Conference*
  Jones, H., Rock, S.
  IEEE.2002: 3645–3653
- **Field experiments in the control of a jellyfish tracking ROV** *MTS/IEEE Oceans 2002 Conference*
  Rife, J., Rock, S. M.
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- **Applying kinodynamic randomized motion planning with a dynamic priority system to multi-robot space systems** *IEEE Aerospace Conference*
  Clark, C. M., Bretl, T., Rock, S.
  IEEE.2002: 3621–3631
- **Relative position estimation for AUVs by fusing bearing and inertial rate sensor measurements** *MTS/IEEE Oceans 2002 Conference*
  Huster, A., Frew, E. W., Rock, S. M.
  IEEE.2002: 1863–1870
- **Kinematic path-planning for formations of mobile robots with a nonholonomic constraint** *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2002)*
  Barfoot, T. D., Clark, C. M., Rock, S. M., D'Eleuterio, G. M.
  IEEE.2002: 2819–2824
- **Field demonstration of a mars navigation system utilizing GPS pseudolite transceivers** *IEEE Position Location and Navigation Symposium*
  LeMaster, E. A., Matsuoka, M., Rock, S. M.
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- **Exploratory motion generation for monocular vision-based target localization** *IEEE Aerospace Conference*
  Frew, E. W., Rock, S.
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- **Applying Kinodynamic Randomized Motion Planning with a Dynamic Priority System to Multi-Robot Space Systems**
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- **Kinematic Path-planning for Formations of Mobile Robots with a Nonholonomic Constraint**
  Barfoot, T., D., Clark, C., M., Rock, S., M., D'Eleuterio, G., M. T.
  2002
- **Field Demonstration of a Mars Navigation System Utilizing GPS Pseudolite Transceivers**
  LeMaster, E., A., Matsuoka, M., Rock, S., M.
  2002
- **Planning Robust Dynamic Transitions for Enhanced Mobility of Planetary Rovers**
  Bretl, T., C., Rock, S., M.
  2002
- **An Improved Solution Algorithm for Self-Calibrating Pseudolite Arrays**
  LeMaster, E., A., Rock, S., M.
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- **Robust Execution of Aggressive Maneuvers for Planetary Robotics**
  Bretl, T., C., Rock, S., M.
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- **Exploratory Motion Generation for Monocular Vision-Based Target Localization**
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- **Field Experiments in the Control of a Jellyfish Tracking ROV**
  Rife, J., Rock, S., M.
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- **Autonomous Robots in SWAT Applications: Research, Design, and Operations Challenges**
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- **Relative Position Estimation for AUVs by Fusing Bearing and Inertial Rate Sensor Measurements**
  Huster, A., Frew, E., W., Rock, S., M.
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- **Quantification of cyclic motion of marine animals from computer vision** *MTS/IEEE Oceans 2002 Conference*
  Plotnik, A. M., Rock, S. M.
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- **Nonlinear flight control using forebody tangential blowing** *JOURNAL OF GUIDANCE CONTROL AND DYNAMICS*
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- **Randomized kinodynamic motion planning with moving obstacles** *4th International Workshop on the Algorithmic Foundations of Robotics (WAFR)*
  Hsu, D., Kindel, R., Latombe, J. C., Rock, S.
  A K PETERS, LTD.2001: 247–264
- **A Local-Area GPS Pseudolite-Based Mars Navigation System**
  LeMaster, E., A., Rock, S., M.
  2001
- **A Pilot-Aid for ROV Based Tracking of Gelatinous Animals in the Midwater**
  Rife, J., Rock, S., M.
  2001
- **Visual Tracking of Jellyfish In Situ**
  Rife, J., Rock, S., M.
  2001
- **Relative Position Estimation for Intervention-Capable AUVs by Fusing Vision and Inertial Measurements**
  Huster, A., Rock, S., M.
  2001
- **Randomized Motion Planning for Groups of Nonholonomic Robots**
  Clark, C., M., Rock, S., M.
  2001
- **Relative Position Estimation for Manipulation Tasks by Fusing Vision and Inertial Measurements**
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- **Kinodynamic Motion Planning Amidst Moving Obstacles**
  Kindel, R., Hsu, D., Latombe, J., C., Rock, S., M.
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- **Field Test Results for a Self-Calibrating Pseudolite Array**
  LeMaster, E., A., Rock, S., M.
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- **Aileron effectiveness at high angles of attack: Interaction with forebody blowing** *AIAA Atmospheric Flight Mechanics Conference*
  Pedreiro, N., Takahara, Y., Rock, S. M.
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- **GPS Pseudolite Transceivers and their Applications**
  Stone, J., M., LeMaster, E., A., Powell, D., J., Rock, S., M.
  1999

- **Self-Calibration of Pseudolite Arrays Using Self-Differencing Transceivers**
  LeMaster, E., A., Rock, S., M.
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- **Cooperative research in underwater robot mission-level programming methodologies** *INTERNATIONAL JOURNAL OF SYSTEMS SCIENCE*
  Coste-Maniere, E., Wang, H. H., Rock, S. M., Rigaud, V., Peuch, A., Perrier, M.
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- **Human-Robot Interaction for Field Operation of an Autonomous Helicopter** *Mobile Robots XIII and Intelligent Transportation Systems*
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- **Combined CDGPS and Vision-Based Control of a Small Autonomous Helicopter**
  Rock, S., M., Frew, E., Jones, H., Woodley, B., R., LeMaster, E., A.
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- **Model Development of an Underwater Manipulator for Coordinated Arm-Vehicle Control**

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- **Experimental Validation of a Real-Time Vision Sensor and Navigation System for Intelligent Underwater Vehicles**
  Fleischer, S., D., Rock, S., M.
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- **Demonstration of a Vision-Based Dead-Reckoning System for Navigation of an Underwater Vehicle**
  Huster, A., Fleischer, S., D., Rock, S., M.
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- **A Contestant in the 1997 International Aerial Robotics Competition**
  Woodley, B., R., Jones, H., Frew, E., LeMaster, E., A., Rock, S., M.
  1997
- **Global position determination and vehicle path estimation from a vision sensor for real-time video Mosaicking and navigation** *Oceans 97 MTS/IEEE Conference*
  Fleischer, S. D., Rock, S. M., Burton, R.
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- **Station keeping of an ROV using vision technology** *Oceans 97 MTS/IEEE Conference*
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- **OTTER: The design and development of an intelligent underwater robot** *1995 IEEE International Conference on Robotics and Automation - Autonomous Underwater Robots*
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- **Video mosaicking along arbitrary vehicle paths** *1996 Symposium on Autonomous Underwater Vehicle Technology (AUV 96)*
  Fleischer, S. D., Wang, H. H., Rock, S. M., Lee, M. J.
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- **Carrier Phase GPS and Computer Vision for the Control of an Autonomous Helicopter**
  Woodley, B., R., Jones, H., L., LeMaster, E., A., Frew, E., W., Rock, S., M.
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  Miles, D., W., Rock, S., M.
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