Gregg Podnar
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<u>EXPERIENCE</u>

Over three decades of robotics research and development, including the design and fabrication of over a dozen mobile robots; robot arms; and telepresence and sensor systems.

Co-founded the Telesupervised Autonomous Robotics Laboratory in 2004 which includes technology areas for the Multiple Autonomous Robot Telesupervision Architecture that integrates: autonomous navigation, hazard and assistance detection, telepresence and teleoperation.

2004-present   <u>Program Manager</u> – Robotics Institute, Carnegie-Mellon University Pgh., PA.

Conceptualization and development of a system of cooperating robots that form a precision flexible factory floor for robotic large aircraft wing-assembly

Development of very small search-and-rescue robots also useful for exploration of Egyptian monuments and other tight environment inspection.

Co-investigator on predictive management of compound energy storage (moderate-rate batteries and high-rate supercapacitors) for electric passenger vehicles. Awarded grant to install eight electric vehicle charging stations.

Conceptualized, proposed, and program management of "Telesupervised Adaptive Ocean Sensor Fleet", a NASA-funded three-year $1.3M program for human-supervision of a fleet of autonomous ocean-going robot platforms for investigation of Harmful Algal Blooms under NASA's Science Mission Directorate, Earth Science Technology Office. Includes coordination of a multi-disciplinary team spanning NASA Goddard, Wallops, JPL, and CMU. As an extension of this program, developed a kayak-based fleet of Robot Sensor Boats for river water quality assessment.

Conceptualized, proposed, and program management of "Wide Area Prospecting Using Supervised Autonomous Robots", a NASA-funded $2.3M program for human-supervision of a fleet of autonomous mineral prospecting robots under NASA's Exploration Systems Mission Directorate (ESMD) with NASA Ames and JPL.

Developed mechanical systems for microsurgical instruments that provide active compensation of a surgeon's hand tremor.

Developed steerable, flexible needles for deep brain neurosurgery research.

2010 Summer   <u>Visiting Fellow</u> – Commonwealth Scientific and Industrial Research Organization, Sydney, Brisbane, and Canberra, Australia.
Minerals Down Under flagship research program: Future Mines.

Assessed efforts to transition current mineral mining practices to remote operations centers and increasing autonomy leading to proposals of collaborative research and educational programs with the Robotics Institute of Carnegie Mellon University.

1992-2004   <u>Senior Research Engineer</u> – Robotics Institute, Carnegie-Mellon Univ., Pgh., PA.

Responsible for design and implementation of robot systems in a number of labs and centers. Received 1999 "Award for Excellence"from *Industrial Robot*. Participated in proposal writing, development of research plans, and supervision of lab personnel. Responsible for ordering, project scheduling, and coordination of outside services. Includes systems, mechanical, electrical, optical, software, and sensor engineering.

Developed geometrically-accurate stereoscopic video camera systems for remote inspections, stereo compression, and vision research.

Developed a lightweight and portable mobile robot for remote stereoscopic aircraft skin inspection tested on DC-9 at USAirways in Pittsburgh, and on Boeing 747 at Northwest Airlines in Minneapolis. The "Crown Inspection Mobile Platform" has a large, but very lightweight honeycomb frame. Designed to adapt to the curvature of the top portion of the fuselage allowing visual inspectors to find stress cracks, lightning strikes, corrosion, and rivet flaws remotely.

Developed a bench-top mobile robot to test various stereoscopic camera systems and lighting systems on sections of aircraft exterior aluminum skin.

Developed stereoscopic workstations for remote operators. Worked closely with ophthalmology and ENT surgeons to provide stereoscopic recording during tests of binocular stereoscopic endoscopic surgeries at Eye and Ear Hospital.

For the National Robotics Engineering Consortium: modification of industrial forklift trucks for vision-based loading and navigation including: hardened physical positioning sensors and odometry sensors; specialized lighting and structured lighting; high-contrast retro-reflective fiducials; cameras systems for navigation and materials handling; on-board high current power distribution. Adapted research technology for use in automobile manufacturing plant settings.

Developed purpose-built robot arms to reliably turn pages in books for electronic imaging of libraries. Worked closely with team members to develop a novel configuration with simplified control requirements which allowed the arms to be completed on an extremely ambitious schedule.

1993-present   <u>Chief Engineer</u> – Accommodata Corporation, Cleveland, OH.
Co-founder and chief technical officer of Accommodata Corporation which develops networked computer-based vision examination systems and telemedicine imaging systems.   `<www.accommodata.com>`
Have worked closely with physicians to address their examination needs, and the development of new vision tests including binocular and stereoscopic tests.

1990-1991   <u>Visiting Professor</u> – Computer Science Department, JiangXi University
NanChang, JiangXi Province, China.
Taught Artificial Intelligence and lectured on Robotics.

1987-1990   <u>Research Associate</u> – Engineering Design Research Center, CMU, Pgh., PA.
Research on shared environments for group engineering design.
Co-founded the *n*-Dim Group for *n*-Dimensional Information Modeling.
Member of the Computer Science Facilities Advisory Committee.

1981-1987   <u>Project Engineer</u> – Mobile Robot Laboratory, Robotics Institute, CMU, Pgh., PA.

Design and construction of mobile robot vehicles and modular manipulators.
Video and sensor systems for navigation research; communication systems;
and power electronics. Supervised laboratory personnel and on-campus machine
shop for subsystems development, fabrication and integration. Worked closely
with faculty and graduate students on systems in support of their research.

Design and fabrication of a three-wheeled vehicle for sonar, and stereoscopic
vision navigation and path planning research. Two commercial research labs
copied this vehicle. Completed under budget, and within a very limited schedule.

Redesigned an unworkable omni-directional mobile robot vehicle using differential
synchronous drives. Used successfully for laboratory vision and navigation
research. Currently in the Computer Museum, Boston, MA.

Omni-directional research vehicle using MECANUM wheels. Four-wheel drive with
independent suspension. Can carry a 100 kg payload on a 7% slope. Used for
over two decades in many vision and navigation projects, and as a prototype base
for Space Shuttle tile inspection.

<u>CONSULTING and OTHER EXPERIENCE</u>

Technical Reviewer for Department of Energy Vehicles Program proposals.
Deep brain access instruments for endoscopic surgery.
Wheelchair turntable studies for public transit including full-scale testing.
Design of instrument for net-shape bone cutting for knee replacement surgery.
Strategic planning for demonstrations of the National Research Network of Brazil.
Head position controlled microphone switching system for quadriplegics.
Engineering on mobile robots and grippers for assisting disabled individuals.
Patient-position alarm for ophthalmic operating lasers.
Laminar-flow nozzles for architectural fountains.
Electronic engine timing under hot-test for Ford Motor Company.
Volunteer work for the Rehabilitation Institute of Pittsburgh, Engineering Dept.
Photography: Discover Magazine, Robotics Age, Pittsburgh Engineer (cover).
Producer / Writer / Director – GLCH Productions, Pittsburgh, PA.
     "Computers in Your Life", Association for Computing Machinery.
Fellow – Center for Art and Technology, School of Fine Arts, Carnegie-Mellon.
Motorizing kinetic sculpture.

Radio-control ventriloquist figure.
Established video and photography department of CMU's Robotics Institute.
Designer / Engineer – Digital Art Exchange, a telematic art group.
    "Network Planetario" – International Pavilion of Art and Science
      42nd Venice Biennale - 1986
Instructor – Calligraphy, Euclid Art Association, 1977.

PATENTS

"Computerized optometer and medical office management system"
U.S. Patent: 6,108,634, Germany Patent: 19781691, U.K. Patent: 2329992
Canada Patent: 2,251,080, Japan Patent: 3302697   Other patents pending.

"Accessible Display System" - U.S. Patent 7,877,692.

Pending: "Endoscopic Ports for Minimally Invasive Surgical Access and
      Methods of Use Thereof" - Application: PCT/US2011/054957

AWARDS

NASA Tech Brief Award, for technical innovation contributing to the National
Space Program, and to the mission of the Jet Propulsion Laboratory for:
"The Telesupervised Adaptive Ocean Sensor Fleet", 2008.

SAE International 20-Year Member Service Award, 2005.

Literati Club, 1999 Award for Excellence
For publication: "Robotic Assistants for Aircraft Inspectors", published in
Industrial ROBOT, Vol.25, No.6, MCB University Press 1998.

Distinguished Teacher Commendation, Computer Science Department
JiangXi University, NanChang, China, 1991.

Norman Carr Honor Award, for outstanding merit in Communications,
Textile Veterans Association, 1976.

MEMBERSHIPS

Society for Automotive Engineers (since 1985)
    Judge for 8th Annual SAE Robotic Walking Machine Decathlon.
American Institute for Aeronautics and Astronautics
American Geophysical Union
National Stereoscopic Association.

EDUCATION

1976   Bachelor of Science Degree, Carnegie-Mellon University
      Student Defined Major – including areas of study in:
      Computer Science, Design, Electrical Engineering, Psychology.

1985   Eight graduate credits in Artificial Intelligence and Programming Systems
      in the School for Computer Science, Carnegie-Mellon University.

PUBLICATIONS

Robert A. MacLachlan, Brian C. Becker, Jaime Cuevas Tabarés, G. Podnar, Louis A. Lobes, Cameron Riviere, *Micron: an Actively Stabilized Handheld Tool for Microsurgery*, IEEE Transactions on Robotics (IEEE Transactions on Robotics, vol. 28, no. 1, February 2012).

A. Styler, G. Podnar, P. Dille, M. Duescher, C. Bartley, I. Nourbakhsh, *Active Management of a Heterogeneous Energy Store for Electric Vehicles*, 2011 IEEE Forum on Integrated and Sustainable Transportation Systems, Vienna, Austria. <http://water.tsar.ri.cmu.edu/~gwp/gwp/gwpPublications/ieeefists2011chargecaralgorithms.pdf>

G. Podnar, J. Dolan, A. Elfes, *Telesupervision of Environmental Water Science Sensor Robots,* American Geophysical Union, December 2010.

G. Podnar, J. Dolan, A. Elfes, *Telesupervised Robotic Systems and the Human Exploration of Mars,* Journal of Cosmology, 2010, Vol 12, JournalofCosmology.com, October-November, 2010. And in book form.

G. Podnar, J. Dolan, Kian Hsiang Low, A. Elfes, *Telesupervised Remote Surface Water Quality Sensing,* IEEE Aerospace Conference, Big Sky, MO, March, 2010.

A. Elfes, D. Clouse, M. Powell, E. A. Kulczycki, J. L. Hall, G. Podnar, J. M. Dolan, *Robotic Platforms for Rapid Prototyping and Deployment of Sensor Systems in Support of Orbital Surveys,* IEEE Aerospace Conference, Big Sky, MO, March, 2010.

Kian Hsiang Low, G. Podnar, S. Stancliff, J. Dolan, A. Elfes, *Robot Boats as a Mobile Aquatic Sensor Network,* Workshop on Sensor Networks for Earth and Space Science Applications: In Proceedings of the IPSN-09 Workshop on Sensor Networks for Earth and Space Science Applications (ESSA-09), San Francisco, CA, Apr 16, 2009.

G. Podnar, J. Dolan, A. Elfes, *Networked Architecture for Robotic Environmental Ocean Science Sensors*, Workshop Proceedings Sensing a Changing World, Centre for Geo-information, ISSN 1568-1874, Wageningen University and Research Centre, Wageningen, The Netherlands, 2008.

A. Elfes, G.W. Podnar, R.F. Tavares Filho, A. Pavani Filho, *Inference Grids for Environmental Mapping and Mission Planning of Autonomous Mobile Environmental Robots*, Workshop Proceedings Sensing a Changing World, Centre for Geo-information, ISSN 1568-1874, Wageningen University and Research Centre, Wageningen, The Netherlands, 2008.

G. Podnar, J. Dolan, A. Elfes, *Operation of Robotic Science Boats Using the Telesupervised Adaptive Ocean Sensor Fleet System*, Proceedings of the 2008 IEEE International Conference on Robotics and Automation (ICRA '08), May 2008.

G. Podnar, J. Dolan, A. Elfes, M. Bergerman, *Multi-Level Autonomy Robot Telesupervision*, Workshop on New Vistas and Challenges in Telerobotics, Proceedings of the 2008 IEEE International Conference on Robotics and Automation (ICRA '08), May 2008.

G. Podnar, J. Dolan, A. Elfes, M. Bergerman, *Human Telesupervision of Very Heterogeneous Planetary Robot Teams*, Proceedings of the 45th AIAA Aerospace Sciences Meeting (AIAA 2007), September, 2007.

A. Elfes, G. Podnar, J. Dolan, S.B. Stancliff, E. Lin, J. Hosler, T. Ames, J. Moisan, T. Moisan, J. Higinbotham, and E. Kulczycki, *The Telesupervised Adaptive Ocean Sensor Fleet*, Proceedings of the SPIE Conference on Atmospheric and Environmental Remote Sensing Data Processing and Utilization III: Readiness for GEOSS, August, 2007.

J. Dolan, G. Podnar, S.B. Stancliff, E. Lin, J. Higinbotham, J. Hosler, T. Ames, J. Moisan, T. Moisan, and A. Elfes, *Harmful Algal Bloom Characterization Via the Telesupervised Adaptive Ocean Sensor Fleet* Proc. NASA Science Technology Conference 2007 (NSTC-07), May, 2007.

J. A. Engh, S. Y. Khoo, G. Podnar, and C. N. Riviere, *Flexible Needle Steering System for Percutaneous Access to Deep Zones of the Brain*, 32nd IEEE Northeast Bioeng. Conf., 2006.

J.A. Engh, MD, G. Podnar, D. Kondziolka, and C. Riviere, *Toward Effective Needle Steering in Brain Tissue*. 28th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS '06), August, 2006.

Podnar, G.; Dolan J.M.; Elfes, A.; Bergerman, M.; Brown, H.B.; Guisewite, A.D. *Human Telesupervision of a Fleet of Autonomous Robots for Safe and Efficient Space Exploration*. Proceedings of the First Annual Conference on Human-Robot Interaction, March 2006.

Halberstam, E.; Navarro-Serment, L.; Conescu, R.; Mau, S.; Podnar, G.; Guisewite, A.D.; Brown, H.B.; Elfes, A.; Dolan, J.M.; Bergerman, M.; *A Robot Supervision Architecture for Safe and Efficient Space Exploration and Operation*. Tenth Biennial International Conference on Engineering, Construction, and Operations in Challenging Environments: Earth & Space 2006 Conference, ASCE, March, 2006.

Elfes, A.; Dolan, J.M.; Podnar, G.; Mau, S.; Bergerman, M.; *Safe and Efficient Robotic Space Exploration with Tele-Supervised Autonomous Robots*. Proceedings of the AAAI Spring Symposium, March 2006.

J.M. Dolan, G. Podnar, A. Elfes, *Towards a Telesupervisory Multi-Robot Lunar and Planetary Exploration Architecture*, AIAA 2005.

A. Elfes, M. F. M. Campos, M. Bergerman, S. S. Bueno and G. W. Podnar, *A Robotic Unmanned Aerial Vehicle for Environmental Research and Monitoring,* "First Scientific Conference on the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA)", (June 2000) in Belem, Para, Brazil.

M. Siegel, P. Gunatilake, and G. Podnar, *Robotic Assistants for Aircraft Inspectors*, Instrumentation and Measurement Magazine, Vol.1, No.1, March, 1998, pp.16-30. Also published (abridged) in SME's Robotics Today, Vol.11, No.2, 2ndQ, 1998. Also published (with grayscale imagery) in MCB University Press's Industrial ROBOT , Vol. 25, No. 6, 1998, pp. 389 (1999 Literati Club, Award for Excellence)

Gunatilake, P., M. W. Siegel, A. G. Jordan, G. W. Podnar, *Image understanding algorithms for remote visual inspection of aircraft surfaces*, Proceedings of the SPIE Conference on Machine Vision Applications in Industrial Inspection V, San Jose, February 1997, SPIE v. 3029, pp 2-13.

P. Gunatilake, M. Siegel, A. Jordan, and G. Podnar, *Image Enhancement and Understanding for Remote Visual Inspection of Aircraft Surface*, Nondestructive Evaluation of Aging Aircraft, Airports, and Aerospace Hardware, Vol. 2945, December, 1996, pp. 416 - 427.

M. Siegel, V. Grinberg, A. Jordan, J. McVeigh, G. Podnar, S. Safier, S. Sriram, *Software for 3D TV and 3D-Stereoscopic Workstations*, Proceedings 1995 International Workshop on Stereoscopic and Three-Dimensional Imaging, S.N. Efstratiadis et al., Editors, pp. 251-260, Santorini, Greece, September 1995.

V.Grinberg, G.Podnar, M.Siegel, *Geometry of Binocular Imaging II, The Augmented Eye*, Proceedings of IS&T/SPIE Symposium, Stereoscopic Displays and Applications VI, 1995

V.Grinberg, G.Podnar, M.Siegel, *Geometry of Binocular Imaging*, Proceedings of IS&T/SPIE Symposium, Stereoscopic Displays and Applications V, 1994

E. Subrahmanian, A. Westerberg, and G. Podnar, *Towards a Shared Computational Support Environment for Engineering Design*, EDRC Report, 12-36-89, April 1989. And in *Lecture Notes in Computer Science: Collaborative Product Development*, D. Sriram, R. Logcher, and S. Fukuda, eds., Springer-Verlag, Berlin, 1991, pp. 200-226.

E.Subrahmanian, G.Podnar, A.Westerberg, *A Shared Computational Environment for Concurrent Engineering*, presented at the Second Annual Symposium on Concurrent Engineering, Concurrent Engineering Research Center, West Virginia University, 1990.

Westerberg A. W., P. Piela, E. Subrahmanian, G. Podnar, and W. Elm. *A Future Computer Environment for Preliminary Design*. In Foundations of Computer-Aided Process Design. (Edited by In Siirola J. J., Grossmann I.E. and Stephanopoulos G.), pp. 507-528. CACHE, Elsevier, Amsterdam (1989).

A.Westerberg, P.Piela, E.Subrahmanian, G.Podnar, W.Elm, *A Future Computer Environment for Preliminary Design*, Proceedings of the Third International Conference on Computer Aided Process Design, 1989.

Eswaran Subramanian, Arthur Westerberg, Gregg Podnar: *Towards a Shared Computational Environment for Engineering Design*. MIT-JSME Workshop1989: pp. 200-228.

G.Podnar, *Distributed Problem Solving Kernel*, Users' Guide, Engineering Design Research Center, CMU, 1987.

S.Talukdar, E.Cardozo, G.Podnar, *Building Large-Scale Software Organization*, In: Coupling Symbolic and Numerical Computing in Expert Systems, Amsterdam, 1988.

S.Talukdar, E.Cardozo, G.Podnar, *Coupling Symbolic and Numeric Programs in Large-Scale Software Organizations*, research report, EDRC, CMU, 1987.

G.Podnar, B.Breland, *Monday Magazine*, an irregular periodical reporting international telecommunications art, the Digital Art Exchange, Department of Art, CMU, 1986-1987.

G.Podnar, *A Sophisticated Omni-Directional Vehicle for Autonomous Mobile Robot Research*, technical report, The Robotics Institute, Carnegie Mellon University, 1986.

H. Moravec, C. Thorpe, G. Podnar, and P. Muir, *Autonomous Mobile Robots, Annual Report*, tech. report CMU-RI-TR-86-04, Robotics Institute, Carnegie Mellon University, February, 1985.

Gregg Podnar, *The Neptune Mobile Robot*, <u>Autonomous Mobile Robots Annual Report 1985,</u> The Robotics Institute, Carnegie Mellon University, Technical Report CMU-RI-TR-86-4, 1985, pp.123-125

Gregg Podnar, *Physical System of a Mobile Robot: Pluto*, technical report, The Robotics Institute, Carnegie Mellon University, 1985.

G.Podnar, M.Blackwell, K.Dowling, *A Functional Vehicle for Autonomous Mobile Robot Research*, technical report, The Robotics Institute, CMU, 1984.