THE EXPERTS
Robson Forensic

RICHARD T. MURRAY, P.E.
Mechanical Engineer
Product & Machinery Design, Workplace Safety, and Human Factors

ENGINEERING AND TECHNICAL EXPERIENCE

Core Technical Areas:

Kinematic and dynamic analysis of machinery, mechanisms, and mechanical devices; failure analysis and root-cause analysis; product design and development including human factors, warnings, and safety instructions; identification and causality of defects/deficiencies in design, manufacturing, testing, maintenance, and operation of mechanical systems; manufacturing processes (including traditional and modern); impact, shock, and vibration; automation and industrial processes; strength and stability of frames and structures.

Specialty Expertise:

Automation Equipment: (including fully automated systems, human operator-assisted systems, and robot-integrated systems); electrical and pneumatic actuators and motors (linear and rotary); cutters and blades; web handling and form-fill-seal packaging machinery; vacuum sealing; presses and die sets; welding and annealing equipment; sorting machines; conveyors, and material handling systems; machine instructions/manuals, safety, guarding, enclosures, warning labels, interlocks, and emergency stops; robotic integration, mounting, end effector design, and motion planning.

Manufacturing Processes: including conventional and CNC drilling, tapping, milling, turning, and grinding; welding processes including Shielded Metal Arc Welding (“stick”), Gas Metal Arc Welding (MIG), Gas Tungsten Arc Welding (TIG/Heliarc), and Laser Beam Welding; oxy-acetylene welding, brazing, and cutting; heat treating; sawing; boring, and broaching; sheet metal fabrication.

Assembly Processes: including bolted riveted joint, and joint design; fastener selection, torque specification, and loosening/tampering prevention; precision alignment techniques; press and shrink fitting; gaskets and seals; bonded joints (adhesives).

Materials: including selection and testing based on strength, thermal properties, wear resistance, fatigue resistance, elasticity, etc.

Analysis and design of frames and structures subjected to static and/or dynamic loads.

Analysis and Design of Machinery and Machine Elements: including stress and strain analysis; component failure prevention; linkages and cams; springs and flexures; bearings; gears and gear trains; clutches, brakes, couplings, and flywheels; power transmitting belts and chains; wire ropes and chains; shafts and axles; pressure and vacuum piping, fittings, and vessels.

Product Design and Development: including concept generation and evaluation; safety and hazard analyses; optimization; Computer Aided Design (CAD); Design for Assembly and Design for Manufacturing; schematics, blueprints, and assembly instructions; specification of Limits and Fits and Geometric Dimensioning and Tolerancing (GD&T); operation manuals/instructions.

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Safety and Human Factors: including hazard analyses of products and systems; identification, elimination and control of hazards; human-centered design and ergonomics; design and application of safeguards and warnings; specification of personal protective equipment (PPE); identification and application of safety standards.

Industrial Operations and Maintenance: Millwrighting, rigging, alignment, and balancing; preventive and predictive maintenance; heavy trucking, warehousing, materials handling, design and construction of wooden shipping crates and pallets.

Specialized Industries and Processes: including medical device assembly and packaging; high-g shock and vibration hardening; computerized vision systems; research and development of novel mechanical systems; electrical and pyrotechnic initiation devices; energy harvesting; piezoelectric materials; design of experiments and laboratory apparatus.

SUPERVISORY EXPERIENCE

Supervise, train, and mentor junior engineers, machinists, and technicians in industrial and laboratory settings.

PROJECT MANAGEMENT EXPERIENCE

Author project proposals; develop, maintain, and monitor project budgets and schedules; vet and negotiate with suppliers; manage outsourced services (machining, welding, coatings, specialty processes); specify and source major capital equipment acquisitions; compose technical reports, patent applications, presentations, and marketing materials.

PROFESSIONAL EXPERIENCE

2022 to Present **Robson Forensic, Inc.**
Associate
Provide technical investigations, analysis, reports, and testimony toward the resolution of commercial and personal injury litigation involving:

- machinery, mechanisms, and mechanical devices,
- consumer and industrial/commercial products,
- ladders and scaffolds,
- warnings and safety instructions, and
- chairs and other furniture.

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2016 to 2022 **Coastal Carolina University/Department of Physics and Engineering Science**
Teaching Associate
Instructor of Record for ENGR-102—Engineering Graphics Communication and ENGR-234—Engineering Mechanics I: Statics. In ENGR 102: Delivered a comprehensive curriculum ensuring that students can effectively communicate their design intents (or interpret the intents of others) throughout the engineering design process. In ENGR 234: Instructed students in the rigorous analysis of statically determinate systems. Focus was on efficient, systematic, and thorough analysis by presenting strategies to attack broad classes of physical systems.

Laboratory/Recitation Instructor for introductory physics courses. Provided focused instruction to individuals or groups performing in-class problem-solving and laboratory experiments. Worked with students to unwind misconceptions and gain a true understanding of the phenomena at hand, as well as demonstrated straightforward, systematic, and efficient approaches to solving problems and running experiments. The goal of these efforts was to impart the conceptual knowledge, computational skills, and general confidence needed for students to independently reach correct solutions to complex problems.

2015 to 2016 **Solara Automation**
Mechanical Engineer
Designed custom automated industrial workcells incorporating robots and machine vision. Designed human-interfaced workstations with a focus on safety, usability, and ergonomics. Principal Engineer on a variety of major projects, from spearheading conceptual design activities, to performing engineering analysis and detailed mechanical and ergonomic design. Worked closely with controls engineers, vision specialists, and robot programmers. Coordinated with shop foreman to oversee fabrication. Performed hazard analyses and implemented hazard controls including safeguards, warnings, and safety instructions.

2014 to 2015 **Dri Mark Products, Inc.**
Engineering Consultant
Diagnosed and repaired mechanical, electrical, pneumatic, and hydraulic systems in a plant with 20+ automated assembly and packaging machines as well as 13 injection molding machines. Developed plans for modernizing the in-house machine shop. Evaluated the organization's current maintenance, repair, and overhaul procedures and develop plans for improvement, including plant and machine shop safety. Screened and interviewed candidates for machinist, mechanic, and technical positions.

2013 to 2014 **Adaptive Manufacturing Technologies/Quick Pouch**
Senior Mechanical Engineer and Project Manager
Generated conceptual and detailed designs of custom automatic loading and post-processing equipment to interface with the company's standard line of form-fill-seal packaging machines. Design tasks included human-centered design and ergonomics. Executed high-level, mission-critical engineering tasks while directing junior engineers and drafters to complete more basic

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design work. Performed hazard analyses and implemented hazard controls including safeguards, warnings, and safety instructions.

2006 to 2019 **Omnitek Partners, LLC**

Facility Security Officer (FSO) *2009-2019*

Worked with the Department of Defense's Defense Security Service to ensure the company's compliance with the National Industrial Security Program. Trained to identify threats and vulnerabilities to classified and proprietary information and materials. Conducted semiannual audits of the company's program and reported to Industrial Security Service representatives.

Senior Mechanical Engineer and Project Manager *2006-2013*

Generated conceptual designs, detailed designs, and directed the manufacturing (in-house and outsourced) of a wide array of products throughout their lifecycles in an innovation, research, and development laboratory dedicated to developing novel solutions to highly challenging or previously unaddressed technical problems, mainly under contract with the Department of Defense. Extensive design work ensuring safety against human and mechanical failure. Documentation of work procedures including warnings and safety instructions. Searched solicitation listings and authored technical proposals; conceptual design, analysis, modeling, detailed design, testing, implementation, publishing of results, and transitioning prototypes into production designs. Expertise in energy harvesting, inertia-driven mechanisms, high-G hardening, construction of laboratory and test equipment, and more generally the development and refinement of conceptual designs in novel mechanical systems. Managed safety of: in-house machine shop, explosive material storage/handling, and laboratory experiments. Ensured compliance with safety standards applicable to products developed.

Recruited, interviewed, and recommended job candidates. Trained and mentored machine shop and technical staff.

2003 to 2006 **Adaptive Manufacturing Technologies**

Mechanical Engineer *2005-2006*

Developed conceptual and detailed designs for custom automation machinery. Human-centered design including load/unload stations and control panel requirements. Extensive use of Solidworks 3D modeling software. Worked with machinists and assembly mechanics to bring projects to completion. Maintained task lists, schedules, bills of materials, and participated in procurement. Performed hazard analyses and implemented hazard controls including safeguards, warnings, and safety instructions.

Machine Builder *2003-2005*

Mechanical and electrical construction and troubleshooting of complex automation machines. Performed welding and finishing of machine frames; wiring of electrical panels; conventional machining of parts (lathe, mill, surface grinder); CNC machining of parts (writing g-code, CNC tooling and setup, program execution);

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building, mounting, aligning, plumbing, and wiring subassemblies; constructing and installing safety and guarding systems; troubleshooting completed machines; factory acceptance testing; readying machines for shipping, including placement of warning signs and labels.

2002 to 2003 **J&S Precision Balancing/Analysis Technology Systems**
Mechanical Technician
Executed corrective action projects: repairing, aligning, and balancing rotary machinery that was found to be in poor condition by a vibration analyst. Mainly performed field service work with high-capacity air handlers, HVAC equipment, and industrial process machinery.

1997 to 2002 **Straightline Transportation**
Mechanical Technician / Owner
Operated and maintained a small fleet of light, medium, and heavy-duty trucks and trailers in a family-owned business. Operated a wide range of manual and powered material handling equipment. Developed maintenance schedules and performed mechanical repairs to trucks, trailers, and equipment. Maintained Class-A Commercial Driver's License (CDL) with endorsements for Hazardous Materials, Double and Triple Trailers, Tow Trucks, and Busses. Developed schedules and optimized logistics in a rapidly changing environment.

PROFESSIONAL CREDENTIALS

Licensed Engineer: Alabama, California, Connecticut, Florida, Georgia, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Montana, New York, North Carolina, Pennsylvania, South Carolina, West Virginia
Certified Solidworks Professional (CSWP): Mechanical Design
Certified Solidworks Professional (CSWP): Advanced Drawing Tools
Solidworks Accredited Educator

EDUCATION

M.S., Mechanical Engineering, Stony Brook University, Stony Brook, New York
B.Eng., Mechanical Engineering, Stony Brook University, Stony Brook, New York

CONTINUING EDUCATION

OSHA 10 Hour General Industry, ClickSafety, 2022
Accelerated Welding Trades, Eastern Suffolk BOCES Milliken Technical Center, 2001
Machining and Manufacturing Workshop, Stony Brook University, 2000

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PROFESSIONAL MEMBERSHIPS

American Society of Mechanical Engineers (ASME)
ASTM International
American Welding Society (AWS)

CONFERENCE PROCEEDINGS

Ervin, Matthew, Carlos Pereira, John Miller, Ronald Outlaw, Jay Rastegar, and **Richard Murray**. "High Frequency Supercapacitors for Piezo-based Energy Harvesting." In APS March Meeting Abstracts, vol. 2013, pp. Q1-317. 2013.

Jahangir Rastegar and **Richard Murray**. “Development of High-Efficiency Piezoelectric-Based Energy Harvesting Power Sources Using Motion-Doubling Mechanisms”. In: Smart Materials, Adaptive Structures and Intelligent Systems. Vol. 56048. American Society of Mechanical Engineers. 2013, V002T07A025.

Jahangir Rastegar and **Richard Murray**. “Novel Two-Stage Electrical Energy Generators for Low and Variable Speed Rotary Machinery”. In: Smart Materials, Adaptive Structures and Intelligent Systems. Vol. 56048. American Society of Mechanical Engineers. 2013, V002T07A024.

J Rastegar, **R Murray**, and M Bridge. “Energy harvesting device for power generation onboard gravity-dropped weapons”. In: Active and Passive Smart Structures and Integrated Systems 2012. Vol. 8341. International Society for Optics and Photonics. 2012, p. 83411C.

J Rastegar, **R Murray**, and C Pereira. “Novel motion-doubling mechanism for improved piezoelectric energy harvesting performance”. In: Active and Passive Smart Structures and Integrated Systems 2012. Vol. 8341. SPIE. 2012, pp. 516–523.

J. Rastegar, **R. Murray**, R. Tillinghast, C. Pereira, H.-L. Nguyen. “Energy harvesting from mortar tube firing impulse to supplement fire-control electronics battery”. In: Energy Harvesting and Storage: Materials, Devices, and Applications II. Vol. 8035. International Society for Optics and Photonics. 2011, p. 803516.

J. Rastegar, **R. Murray**, C. Pereira, H.-L. Nguyen. “Energy-harvesting power sources for gun-fired munitions”. In: Energy Harvesting and Storage: Materials, Devices, and Applications II. Vol. 8035. SPIE. 2011, pp. 269–277.

J. Rastegar, **R. Murray**, C. Pereira, H-L. Nguyen. “Energy-harvesting power sources for very-high-G gun-fired munitions”. In: Active and Passive Smart Structures and Integrated Systems 2010. Vol. 7643. International Society for Optics and Photonics. 2010, p. 76430D.

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Richard Murray and Jahangir Rastegar. “A Review of Three Patents Relating to the Development of Novel Inertia-Driven Mechanisms for Igniters On-Board Gun-Fired Munitions”. In: International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Vol. 44106. 2010, pp. 1217–1218.

J Rastegar and **R Murray**. “Development and commercialization strategy for piezoelectric energy-harvesting power sources for gun-fired munitions”. In: Industrial and Commercial Applications of Smart Structures Technologies 2010. Vol. 7645. International Society for Optics and Photonics. 2010, p. 764502.

J Rastegar and **R Murray**. “Novel two-stage piezoelectric-based electrical energy generators for low and variable speed rotary machinery”. In: Active and Passive Smart Structures and Integrated Systems 2010. Vol. 7643. SPIE. 2010, pp. 110–117.

Jahangir Rastegar and **Richard Murray**. “A Review of Two Patents Relating to Novel Energy Harvesting Techniques to Provide Electrical Power On-Board Gun-Fired Projectiles”. In: International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Vol. 44106. 2010, pp. 1213–1215.

R Murray and J Rastegar. “Novel Multi-Stage Inertia-Driven Delay and Switching Mechanisms”. In: International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Vol. 49040. 2009, pp. 781–787.

R Murray and J Rastegar. “Novel Two-Stage Electrical Energy Generators for Highly-Variable and Low Speed Linear or Rotary Input Motions”. In: International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Vol. 49040. 2009, pp. 789–796.

R Murray and J Rastegar. “Novel two-stage piezoelectric-based ocean wave energy harvesters for moored or unmoored buoys”. In: Active and Passive Smart Structures and Integrated Systems 2009. Vol. 7288. SPIE. 2009, pp. 184–195.

J Rastegar and **R Murray**. “Novel two-stage piezoelectric-based electrical energy generators for low and variable speed rotary machinery”. In: Active and Passive Smart Structures and Integrated Systems 2009. Vol. 7288. International Society for Optics and Photonics. 2009, 72880B.

J. Rastegar, **R. Murray**, C. Pereira, H.-L. Nguyen. “Event sensing and energy-harvesting power sources for gun-fired munitions”. In: Active and Passive Smart Structures and Integrated Systems 2009. Vol. 7288. International Society for Optics and Photonics. 2009, 72880Z.

J. Rastegar, **R. Murray**, C. Pereira, H.-L. Nguyen. “Integrated Event Sensing and Energy-Harvesting Power Sources for Gun-Fred Munitions”. In: SPIE 16th Annual International Symposium on: Smart Structures and Materials and Nondestructive Evaluation and Health Monitoring. Vol. 7288. 2009, p. 34.

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Jahangir S Rastegar and **Richard T Murray**. "Novel Two-Stage Electrical Energy Generators for Highly Variable and Low-Speed Linear or Rotary Input Motions". In: International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Vol. 43260. 2008, pp. 533–540.

J Rastegar and **R Murray**. "Novel vibration-based electrical energy generators for low and variable speed turbo-machinery". In: Industrial and Commercial Applications of Smart Structures Technologies 2007. Vol. 6527. SPIE. 2007, pp. 297–304.

J. Rastegar, **R. Murray**, C. Pereira, H-L. Nguyen. "Novel impact-based peak-energy locking piezoelectric generators for munitions". In: Industrial and Commercial Applications of Smart Structures Technologies 2007. Vol. 6527. SPIE. 2007, pp. 285–290.

J. Rastegar, **R. Murray**, C. Pereira, H.-L. Nguyen. "Novel piezoelectric-based energy-harvesting power sources for gun-fired munitions". In: Industrial and Commercial Applications of Smart Structures Technologies 2007. Vol. 6527. SPIE. 2007, pp. 291–296.

PUBLICATIONS

M. H. Ervin, C. M. Pereira, J. R. Miller, R. A. Outlaw, J. Rastegar and **R. T. Murray** "Graphene-based and other electrochemical double layer capacitors for energy harvesting systems". In: ECS Journal of Solid State Science and Technology 2.10 (2013), p. M3135.

J Rastegar, H Soroff, and **RT Murray**. "Development of an Automated Laser Debridement System for Cutaneous Injuries". In: Journal of Medical Devices 2.2 (2008).

Richard Murray. "Energy-harvesting power sources for a wide range of applications". In: SPIE Newsroom (Jan. 2007). DOI: 10.1117/2.1200707.0810.

PATENTS

Collision barrier device for projecting loads, U.S. Patent #7708324, Published May 4, 2010.

Programmable inertial igniters for gun-fired munitions, thermal batteries and the like, U.S. Patent #8061271. Published November 22, 2011.

Portable wheelchair lift, U.S. Patent #7395900, Published July 8, 2008.

Mechanical delay mechanisms for inertial igniters for thermal batteries and the like, U.S. Patent #7587980, Published September 15, 2009.

Multi-stage mechanical delay mechanisms for inertial igniters for thermal batteries and the like. U.S. Patent #7587979, Published September 15, 2009.

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Axially compact and low-volume mechanical igniter for thermal batteries and the like. U.S. Patent #7832335, Published November 16, 2010.

Compact and low-volume mechanical igniter and ignition systems for thermal batteries and the like. U.S. Patent #9160009, Published October 13, 2015.

Dynamo-type lanyard operated event detection and power generators. U.S. Patent #9112390, Published August 18, 2015.

Electrical generators for use in unmoored buoys and the like platforms with low-frequency and time-varying oscillatory motions. U.S. Patent #8134281, Published March 13, 2012.

Generators for very-high-G energy harvesting. U.S. Patent #8525392, Published September 3, 2013.

Gravity dropped munition having energy harvesting device for power generation onboard munition. U.S. Patent #10030958, Published July 7, 2018.

Gravity dropped small weapon electronic safe arm fuze and energy harvesting device for power generation onboard gravity dropped weapons. U.S. Patent #9383180, Published July 5, 2016.

Inertial igniters with safety pin for initiation with low setback acceleration. U.S. Patent App. #12/794763, Published December 8, 2011.

Method for generating power in a gravity dropped munition. U.S. Patent 9976839, May 22, 2018.

Miniature safe and arm (S and A) mechanisms for fuzing of gravity dropped small weapons. U.S. Patent #8701558, Published April 22, 2014.

Modular, Deployable Weapon System Mount. U.S. Patent App. #12/607322, Published May 27, 2010.

Novel Electrical Generators For Use In Unmoored Buoys And the Like Platforms With Low-Frequency and Time-Varying Oscillatory Motions. U.S. Patent App. #13/925743, Published January 30, 2014.

Power generation devices and methods having a locking element for releasably locking an elastic element storing potential energy. U.S. Patent #9071171, Published June 30, 2015.

Setback and set-forward activated electrical switches. U.S. Patent #8748762, Published June 10, 2014.

Setback and set-forward initiated inertial igniters and activated electrical switches. U.S. Patent #8418617, Published April 16, 2013.

Speed-adaptive deployable boat-tailing cone for munitions for range extension. U.S. Patent #8487227, Published July 16, 2013.

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Compact mechanical inertia igniters for thermal batteries and the like. U.S. Patent #8931413, Published January 13, 2015.

Electrical generators for low-frequency and time-varying rocking and rotary motions. U.S. Patent #8410667, Published April 2, 2013.

Multi-stage mechanical delay mechanisms for inertial igniters for thermal batteries and the like having a rotatable movable member, U.S. Patent #8191476, Published June 5, 2012.

Axially compact mechanical igniter for thermal batteries and the like. U.S. Patent 7437995, Published October 21, 2008.

Countermeasure flares. U.S. Patent #10330446, Published June 25, 2019.

Integrated power source and safety mechanisms for submunitions self-destruct fuze and the like. U.S. Patent #8281719, Published October 9, 2012.

Method for providing electrical energy to a self-destruct fuze for submunitions contained in a projectile. U.S. Patent #9341458, Published May 17, 2016.

Power supply for providing electrical energy to a self-destruct fuze for submunitions contained in a projectile. U.S. Patent #9791252, Published October 17, 2017.

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