Engineering and Aviation Graduate Programs

Addressing Global Challenges

Research Areas
Graduate Programs
Faculty & Leadership

SAINT LOUIS UNIVERSITY
Parks College of Engineering, Aviation and Technology
Welcome from the Graduate Programs Director

“We here, at Parks College, welcome you to our Graduate Programs in Engineering and Aviation. At present, within these programs, there are options for involvement in six major research areas: Biomedical Engineering, Aviation Safety, Thermal-Fluid Sciences, Space Systems, Sustainability and Structural Mechanics and Design. Within each of these areas, a variety of different innovative and state-of-the-art research topics are available for graduate research work, both at the Master degree and the Doctoral degree levels. Our dedicated faculty and staff, including those of us within the Graduate Programs office, are here to mentor, guide and support your graduate school activities to obtain such a degree, as you focus on a specific research topic. As such, your program will be uniquely structured to provide a multi-disciplinary approach, curriculum design flexibility and customized research opportunities to meet your specific career goals.

Pursuing such graduate studies at Saint Louis University will place you on the cutting-edge of research, where a world of discovery and innovation await. The approach of pastoral care and educating the whole person in a manner consistent with its Catholic-Jesuit traditions will make these graduate studies experiences at Saint Louis University unique, fulfilling and rewarding. Completion of your graduate degree will then make you internationally competitive to pursue a career in any avenue of professional activity of your choosing, ranging from employment in multi-national firms, to competitive government agencies, to prestigious academic institutions.”

Phil Ligrani, Ph.D.,
Oliver L. Parks Endowed Chair and
Director of Graduate Programs
Several global challenges have emerged as opportunities for engineering and aviation students of Saint Louis University to make a difference, to apply their education in a context that is technically brilliant, socially responsible and uniquely enterprising, and to ultimately make our world a better, more inclusive place.

Graduate students collaborate with faculty on research in areas such as aviation safety, biomedical engineering, space systems, thermal-fluid sciences, sustainability and structural mechanics and design, the six major areas of research at the college. These efforts address global challenges of the 21st century.

Our six research areas cross traditional disciplines, allowing students to work not only with engineering and aviation faculty, but also with faculty from business, medicine, psychology and chemistry. Together, diverse faculty and students bring multiple perspectives to solve challenging problems.
Biomedical engineering research at Parks College focuses on tissue engineering, biomedical signal processing, orthopedic mechanics and cardiovascular mechanics.

Tissue engineering research utilizes combinations of biomaterials and cells to restore function to otherwise damaged tissue.

Biomedical signal processing research includes the analysis and classification of sleep patterns using statistical signal processing methods.

Orthopedic mechanics research includes design and evaluation of devices for fracture fixation and spinal applications, as well as evaluation of tissue engineered products that support orthopedic implants.

The area of cardiovascular mechanics is aimed at understanding and quantifying how the heart and blood vessels respond to applied forces and pressures.

The goal of biomedical research is to improve the quality of life for humanity.
As commercial aviation continues to grow, the need for sustainable safety programs, initiatives and strategies becomes more critical. To foster a proactive approach to aviation safety, air carriers, maintenance organizations and regulators are shifting to a systems approach to safety.

Safety Management Systems (SMS) offer a systematic approach to safety management, utilizing a common structure that seeks to approach safety as an important aspect of everyday operations. The potential of an effective SMS program supports safety as an ethical imperative and integrates risk management into every aspect of the organization.

The Center for Aviation Safety Research was established at the college through a grant awarded by the Federal Aviation Administration. It focuses on business benefits of Safety Management Systems, safety culture assessment, Maintenance Aviation Safety Action Programs, NextGen safety assessment, multi-risk assessment and incident analysis.
As awareness about the causes of global warming continues to grow, one thing is clear: the production of harmful carbon dioxide gases may lead to catastrophic consequences that threaten human existence. This realization has resulted in a worldwide call to reduce the human “carbon footprint” by using renewable energy sources that produce fewer, if any, CO$_2$ emissions.

SLU researchers are concentrating their efforts on areas such as wind and solar power, green design, infrastructure design, as well as evaluation and restoration to answer the need for a more sustainable planet.

Researchers are working on problems regarding clean water, retrofitting structures and improving energy efficiency. SLU’s Center for Sustainability offers unique research and internship opportunities for graduate students throughout the St. Louis region.
The Space Systems Research Laboratory (SSRL) is a facility for conducting fundamental research and flight demonstrations related to the design, fabrication, testing and operation of space vehicles. A major objective of the laboratory is to improve the performance and reduce the cost of space systems, expressed in four related research topics:

- **Design and Operation of Nano and Pico Spacecraft** - SSRL’s activities in this area include a collaborative space weather mission on a 3-kg spacecraft and an experimental concept for collecting distributed field measurements using low-cost spacecrafts.

- **Space Situational Awareness (SSA)** - SSRL focuses on the use of hyperspectral imagers (visible, infrared and ultraviolet) to identify and define nearby man-made objects (both active spacecraft and debris).

- **Spacecraft Technologies** - SSRL is involved in the development of novel space hardware, including nano reaction wheels, dielectric-barriers and discharge thrusters.

- **Space History, Logistics and Mission Failures** - Using the data from the first 50 years of space flight, SSRL is actively involved in mapping the connections between standard space practices and mission failures in the context of organizational behavior. Using this information, SSRL researchers are developing new approaches to low-cost, reliable space systems.
Structural Mechanics 
and Design

The Structural Mechanics & Design focus area provides researchers and practicing engineers with the skills and knowledge to apply advanced computational and experimental techniques to design, evaluate and improve complex, real-world structures.

A major advantage of the focus area is the investigation of interdisciplinary structural applications that cut across traditional engineering boundaries. Examples include applications involving manufacturing machinery, automotive components, flight vehicle structures, human skeletal systems, non-traditional structural systems and civil engineering structures, such as buildings and bridges.

The focus area emphasizes innovative design and multidisciplinary optimization of static and dynamic structural responses, including seismic behavior, rigid body motions, elastic-plastic deformation and fracture. Advanced techniques in reliability analysis and uncertainty quantification, in conjunction with modern computational tools such as finite element analysis, enable a probabilistic approach in the optimum design of complex multiphysics-based structures.

The focus area provides engineers with the skills and knowledge to work with diverse applications, such as extended-life turbine blades, high productivity rolling mill machinery, lightweight automobile chassis, reliable orthopedic and dental implants, buildings and bridges and adaptive-flexibility structures for micro air vehicles, just to name a few.
Thermal-Fluid Sciences research efforts at Parks College address a full range of problems, including micro- and nano-scale phenomena and galaxy-sized events. Research efforts are underway to simulate the clouds and large vortices that advect in the atmospheres of Uranus and Neptune. More accurate aerial delivery is under investigation by studying the aerodynamics of parachutes and airdrop systems. In the area of turbomachinery, current work examines aerodynamic losses produced by turbine blades and vanes, the design of internal cooling schemes for such blades and vanes, and the development of improved means for film cooling, as measured within transonic turbine airfoil cascades using infrared thermography. Also of interest are micro-fluidic phenomena, as well as separation, fractionation, and purification of micro-particles and nano-particles. Unmanned aerial vehicles are also under development, including research on improving wing design and controlling aerodynamic flows. Research on the fundamentals of fluid physics examines means to identify the laminar-to-turbulent transition process, as part of investigations on the overall nature of turbulence itself.

The implications of such research efforts are important and far reaching, affecting global issues of over-population, pollution, and the environment, as well as energy development and conservation, and the day-to-day well being of every human being and living creature on the planet Earth.
Graduate Programs

The engineering and aviation graduate programs at Saint Louis University are uniquely structured to provide a multi-disciplinary approach, curriculum design flexibility and customized research opportunities to meet the career goals of the individual. Innovation and leadership will be emphasized throughout the programs, producing highly-skilled professionals, well-prepared to pursue careers at multi-national firms, competitive government agencies or prestigious academic institutions.

Undergraduate early-entry options

The SURE Program and the Early-Entry option allow high-performing students a fast track to Master of Science and Ph.D. programs.

The SURE Program

Graduate studies may begin as early as a student’s junior year of undergraduate studies. SURE (Summer Undergraduate Research Experience) gives students the opportunity to work on over 30 research topics in a 10-week summer program, which is designed to prepare students for graduate studies at the college.

To learn more about SURE or to apply, visit the SURE page on our website: parks.slu.edu/current-students/sure

Early-Entry Option

Engineering and aviation students at Parks College may apply for admission to the graduate program in their junior year. During senior year, students admitted to the program will take graduate courses, pending appropriate approvals and satisfaction of related requirements.

This Early-Entry option allows selected students the opportunity to complete both their Bachelor of Science and Master of Science degrees in five years.
Graduate Programs

Requirements

Program requirements

Master’s degree requirements

The minimum requirement for all master’s degrees is 30 credit hours, including up to nine credit hours for thesis research or a project. Faculty mentors may tailor individual curriculum to satisfy the research goals of the students. Industry professionals may complete a course-only degree, with 30 credits of course work. Up to 9 credits may be comprised of course work at the 400 level, the remaining course credits must be at the 500 or 600 level.

Doctoral program requirements

The doctoral programs build on the master’s degree curricula with additional course work focused on a specific research area. The doctoral degree also requires a dissertation, which focuses on a specific research topic.

• The engineering doctoral degree requires a total of 60 credit hours beyond the B.S. degree, including 15-18 credits of dissertation research. Of the 60 credits, a maximum of 9 credits may be comprised of course work at the 400 level; all other course credits must be at the 500 or 600 level.

• The aviation doctoral degree requires a total of 63 credit hours beyond the B.S. degree, including 12 credits of dissertation research, 15 credits in research methods, 9 credits in a secondary discipline and 3 credits in graduate reading.

The program includes a Qualifying Exam at the end of the first year, a Proposal Exam at the end of the second year, and finally, a defense of the Dissertation.

Application dates

Complete applications must be submitted by January 31st to be considered for financial aid (fellowships or graduate research assistantships) for the following Fall semester.

Regular admission applications (without financial aid) may be submitted at any time throughout the calendar year.

Graduate research assistantships

Graduate research assistants work closely with faculty members on specific research topics. Students interested in the graduate research assistantships may apply by submitting their complete application to a graduate degree program by January 31st for consideration for the following Fall Semester. Assistantships provide tuition assistance, a monthly stipend and health insurance.

Additional information

Visit parks.slu.edu/academics/grad-programs/ for more information on graduate programs, or to download the application and other forms needed for admission.
Program Features

Customized degree plan
Each new graduate student prepares a Program of Study that must be approved by their Academic Advisor, Department Chair and the Graduate Programs Director. The program will be reviewed in the context of the student’s background and career goals, allowing students to customize their graduate program to suit their professional goals.

This approach can accommodate students who want to continue toward a doctoral degree, enter the industry with a master’s degree or integrate other areas into their curriculum, such as business, science, medicine, law or public policy.

Course-only option
The course-only option is ideally suited for working professionals. Most courses are offered in evenings for flexibility. Active industry professionals teach some of the courses, bringing in fresh perspectives and addressing current trends. This provides students the opportunity to continue career development and pursue additional education simultaneously.

Research option
The research option is ideal for full-time students interested in pursuing doctoral studies or a research career. These students will typically work in one of the six research areas: aviation safety, biomedical engineering, space systems, sustainability, thermal-fluid sciences or structural mechanics and design.

Our Alumni
As technology alters every facet of our lives, aviation scientists, computer specialists and engineers are more in demand than ever. SLU’s Parks College of Engineering, Aviation and Technology has a worldwide reputation for its aviation and engineering programs.

Our alumni have touched every NASA mission, developed patented technology for wind energy and won national and international awards, making them internationally recognized for their engineering knowledge and expertise.
Apply to a Graduate Program

All inquiries, questions and applications may be directed to:

Director of Graduate Programs
Parks College of Engineering, Aviation and Technology
Saint Louis University
McDonnell Douglas Hall, Room 1033
3450 Lindell Blvd.
Saint Louis, MO 63103, USA
314-977-8306

Visit parks.slu.edu/academics/grad-programs/ for more information on graduate programs, or to download the application, and other forms needed for admission.

Admission requirements
Applicants are required to provide the following:

• On-line application
• Non-refundable application fee of $40 for Fall of 2012 and $55 for Spring of 2013
• Official GRE scores (Saint Louis University Code is 6629)
• Official undergraduate or graduate transcript
• Three letters of recommendation
• Résumé
• Professional goals statement
• Evidence of English language proficiency (when native language is not English)

Admission to the program will include consideration of the following:

• GRE quantitative score greater than 650 (old grading system)
  or greater than 150 (new grading system)*
• Undergraduate GPA of at least 3.0
• Minimum scores for TOEFL PBT 550, TOEFL iBT 80, IELTS 6.5, when the student’s native language is not English

*GRE score requirements may be waived for those students who have successfully passed the Fundamentals of Engineering (FE) exam or who have three or more years of relevant industry or academic experience.
K. Ravindra, Ph.D., P.E., is the Interim Dean of Parks College. He previously served as Associate Dean, Chair of the Aerospace and Mechanical Engineering department and coordinator for the Graduate Programs for Parks College. He has been with Parks since 1987 when he joined the faculty as an Assistant Professor. As Interim Dean, Dr. Ravindra oversees all academic, operational and fiscal aspects of Parks College, which consists of five academic departments with 36 full-time faculty members, 44 staff members and over 550 students. Dr. Ravindra is a fellow of ASME, an associate fellow of AIAA, a member of ASEE and a registered professional engineer. He is an associate member of Sigma Xi, the Scientific Research Society; a member of Tau Beta Pi, the Engineering Honor Society; a member of the Honor Society of Phi Kappa Phi; and he is an honorary member of Alpha Eta Rho. He received the Outstanding Faculty of the Year Award from the Association of Parks College Students in 2003 and 2008 and the Student Government Faculty Excellence Award in Spring 2006.

Phil Ligrani, Ph.D., is the Oliver L. Parks Endowed Chair and Director of Graduate Programs. Previously, he was the Donald Schultz Professor of Turbomachinery in the Department of Engineering Science at the University of Oxford. From 2006 to 2009, he was also the Director of Oxford University’s Rolls-Royce University Technology Centre in Heat Transfer and Aerodynamics. From 1994 to 2006, he was a Professor of Mechanical Engineering, Director of the Convective Heat Transfer Laboratory and Associate Department Chair in the Department of Mechanical Engineering at the University of Utah. Dr. Ligrani’s research interests include turbomachinery, convective heat transfer, fluid mechanics, micro-fluidics, fractionation and separation science, including SPLITT Fractionation. Some of his recent academic recognitions include: Distinguished Editorial Review Board membership for Springer Publishing Corporation, NASA Space Act Tech Brief Award, the Carl E. and Jessie W. Menneken Faculty Award for Excellence in Scientific Research and the “Professor of the Year” award at the University of Utah for outstanding classroom instruction.

David Barnett, D.Sc., Professor and Chair of the Biomedical Engineering department. After his undergraduate studies, Dr. Barnett spent many years in the industry working on electromagnetic scattering codes and radar imaging technology. He also assessed the biological hazards of non-ionizing radiation. After completing his doctoral degree at Washington University in St. Louis, he joined the SLU faculty in 1995 as an Assistant Professor of Electrical Engineering. Dr. Barnett’s research interests focus on biomedical signal processing problems in a variety of areas, including electrophysiology, physiological modeling, sleep research and instrumentation. Dr. Barnett is a member of Sigma Xi, ASEE and BMES. He is a senior member of IEEE and a member of the Honor Societies Tau Beta Pi and Eta Kappa Nu. He received the Outstanding Faculty of the Year Award in 2004 from the Association of Parks College Students. Dr. Barnett joined the Biomedical Engineering department as Chair in 2002.

Swami Karunamorthy, Ph.D., Professor and Chair of Aerospace and Mechanical Engineering department. His areas of research include structural mechanics, composites, applied aerodynamics, helicopter dynamics and kinematics. He is the author of many publications in aerospace engineering, mechanical engineering, engineering education and assessment methods. He is a fellow of ASME, associate fellow of AIAA, Regional Director of AHS and an active member of ASEE. Also, he is a Commissioner and a Program Evaluator at ABET, the Accreditation Board for Engineering, Technology, Computing and Applied Science.

Terrence Kelly, M.S., Professor and Chair in the department of Aviation Science. Professor Kelly has served as a faculty member at Saint Louis University for over 20 years starting with the legacy department of Aircraft Maintenance Engineering. Professor Kelly is a graduate of both Embry Riddle Aeronautical University and Saint Louis University. His research interests include systems safety, organizational safety culture and non-punitive reporting systems. Professor Kelly has worked closely with academic and industry partners on numerous projects in an effort to improve aviation safety.

H. Mallikarjuna, Ph.D., Professor and Chair of the Electrical and Computer Engineering department. He joined Parks in 1989 as an Assistant Professor to the department of Electrical Engineering and was promoted with tenure to Associate Professor in 1995. His teaching interests span control systems, analog and digital filters, linear systems, electric machines and power systems. His research includes electrical power systems and sustainability of energy resources.

John Woolschlager, Ph.D., Professor and founding Chair of the department of Civil Engineering started at Saint Louis University in the 2009-2010 academic year. Prior to joining Saint Louis University, Dr. Woolschlager was an Associate Professor at Arizona State University and the University of North Florida. Dr. Woolschlager had been involved in over $2.5 million worth of collaborative research and engineering projects. Additionally, he was honored with the Student’s Choice Professor Award in 2004 and nominated for the Outstanding Undergraduate Teaching Award in 2004-2005. His research involves developing computer models for environmental processes and systems.