Computing Research & Exchange Program in Sweden

Apply today through the program application portal.
Fellowship Application Deadline: December 20th, 2023
Overview
Undergraduate students will participate in a pioneering exchange- &-research program in Sweden to become globally educated students for international leadership in applied Engineering & Scientific Computing. Students do not pay tuition in Sweden. They will take classes overseas, transfer credits to WSU, and graduate on time. In this program, students will also:

- perform a well-defined research program at internationally ranked Linköping University, which manages Sweden’s National Supercomputer Center and is a partner in the Norrköping Visualization Center

- conduct their research using some of the most advanced high-performance computers in Europe

- explore the development of innovative algorithms via neural networks as well as machine learning

- receive fellowships to complete this program in Sweden

Sponsored by NSF's IRES initiative, this research program in Sweden will involve a total of 21 diverse WSU students, who may apply from any WSU campus. Beginning in the 2023 fall semester, the program will be available during each fall semester for the next three years. During each fall semester, 7 WSU undergraduate students will study in Sweden and complete engineering & scientific computing research projects over an entire semester. Continuing to fulfill their tuition plan with WSU for the semester in Sweden, the students will not have to pay any extra tuition at LiU. Additionally, each participating student will receive a fellowship totaling $12,000.

The students will be hosted by the Computational Mathematics research team with English as the working language, within LiU’s Division of Applied Mathematics, which conducts research that relies on computing as well as software and impacts not only Mathematics, but also Engineering. The WSU PI of this program is
Prof. Dr. Joseph Iannelli (VCEA). The overseas-site director of the project is Prof. Dr. Jan Nordström, a distinguished professor of Computational Mathematics at LiU. Dr. Andrew Winters, a WSU alumnus and Assistant Professor of Computational Mathematics, also at LiU, will supervise the student research projects.

2023 Student Cohort Comments
• “Things are going quite well in Linköping. We see each other every week with our research meetings with Jan and Andrew. In addition, Lindsey, Clara, and I have met a few times for bicycle rides; Sejal, Liam, and Emma traveled to Berlin together; also some of us are planning to travel to Lapland in December for a group trip. Thank you again for everything you did to make this program happen!”

• “I always dreamed of traveling the world, so this could be the start of that adventure. This researching abroad opportunity could lead into more research positions around the world”

• “I am confident that this opportunity will provide me with strong global engineering connections and a broader view of how engineering impacts the world”

• “Through this program I will get a foundation in computational research. This will add onto the laboratory skills that I have already developed and help me be a more versatile and well-rounded researcher”

**Pioneering Reciprocal Exchange Program**
This program integrates a study-abroad semester with a research initiative. Each year, 7 WSU students will complete a study-abroad semester in Sweden and collaborate on research with 7 LiU students who will then reciprocate an exchange semester at WSU and continue to work with the WSU students met at LiU. As a community of scholars, the integrated cohorts of WSU and Swedish students will thus work together for one entire academic year. In Sweden, the LiU students will also assist the WSU students with navigating the Swedish culture and vice-versa in the U.S. where the WSU students will assist the LiU students with the American culture. The students will deepen their acquaintance with one another and thus expand their
future professional network at the international level, fostering greater understanding between different cultures.

**Classes and Academic Credits**

This program incorporates a study-abroad semester. All the participating students will receive academic advisement on the selection of courses to take during the semester overseas. The WSU students will be advised by WSU and LiU advisors as well as the PI and LiU program managers to ensure that the recommended classes at LiU will provide academic credits that not only transfer to WSU, but also apply to the students’ degree requirements for a timely graduation; these LiU classes will be taught in English. Before completing their applications, students should meet with their academic advisors and international advisors over in International Programs. LiU will issue official transcripts of academic records, which will then be used at WSU to apply the LiU credits to each student’s academic records in myWSU.

**Research Projects**

Engineering & Scientific Computing advances knowledge, as it numerically approximates and solves mathematical models in disparate fields, from Aerodynamics to Biology and Economics, to name but a few. In Sweden, students will complete computing research projects that will foster deepen understanding of physical processes in support of design decisions. The students will have access to world-class high-performance computing facilities, such as the largest Tetralith supercomputer, which achieved 3 Petaflops on the LINPACK benchmark, and the considerably faster Berzelius supercomputer, which features 1.5 petabytes of data storage, 480 GPU’s, and a processing speed of 300 Petaflops. Over the three years of this IRES program the specific research projects will vary, but the focus will remain on efficient, high-order accurate, and reliable Engineering & Scientific Computing processes that are optimized for high-performance computer architectures. In their research projects, the scholars will correlate physical modelling, mathematical modelling, and numerical approximations to understand how physical systems function through computer-based simulations that rely on mathematical algorithms. The following are sample projects:

- Selection and Optimization of Linear Solvers for Accurate Boundary Layer Calculations
- Selection and Optimization of Time Integration Algorithms for Steady and Unsteady Flows
- Discrete Differentiation on Smoothly Re-Ordered Point Sets within Boundary Layers
- Spatial Modelling and Discretization through Coordinate Transformations and Basis Functions
Discrete Differentiation on Arbitrary Placed Grid Points though Machine Learning and Artificial Neural Networks
**Professional Development**
The desired overarching outcomes of this program are substantial contributions to the students’ formation as Engineering & Scientific Computing researchers and globally engaged professionals for leadership in globalized societies. Students will be coauthors on journal articles, present their research in Sweden and the U.S., and participate in WSU’s [Showcase for Undergraduate Research and Creative Activities](#). Through this program, accordingly, the students will develop not only novel research abilities, but also additional professional skills and networks that will differentiate them in a competitive employment market both in industry and at universities. These abilities and skills include:

- Communication, presentation, and organization skills
- Mediation of additional faculty-to-faculty collaborations between WSU and LiU
- Development and exploration of new and alternative computational approaches in research for examining scientific problems
- Management of research collaborations in eminently international multicultural environments
- Networking-building skills to foster a community of international scholars and sustain long-term relationships
- Initiation, establishment, and management of international scientific collaborations
- Appreciation of culturally different mindsets and research approaches in international research collaborations

**Cultural Program**
Beyond expanding their research skills and widening their professional network, the IRES scholars will also participate in arranged beneficial cultural activities, so that they may also learn about the cultural, economic, historical, and social aspects of Sweden and its people. A city in southern Sweden and the fifth most populous in the country, Linköping, celebrated its 730th anniversary in 2017 as the center of an old cultural region. Historically, Linköping is famed for its early diocese, first mentioned early in the 12th century. The staff in LiU’s International Office will lead a particularly interesting visit to the Gamla Linköping (Old Linköping) open-air museum.
At LiU, students will take classes and participate in research activities that are conducted in English. They will also be encouraged to take the available Swedish culture and language courses developed for visiting international students. Through these courses, the students will be able to deepen their interactions with people outside the university, make many friends more easily, and appreciate another Germanic language related to English.

A further exciting cultural aspect of this IRES program is that the IRES scholars will be collaborating not only with Swedish students, but also with students from other countries through the active exchange programs that LiU holds with other peer international universities, as these programs welcome around one thousand foreign students every year, attending classes, and creating a stimulating, cosmopolitan campus.
life. The IRES scholars will thus experience the trans-national nature of research in science and engineering in a rich multicultural setting.

**Broader Impacts**
The participating diverse students will take part in potentially transformative computing research that aims to contribute to the expansion of e-design, which reduces development costs, increases quality of initial prototypes, and accelerates introduction of systems into international markets. Supervised by world-class distinguished investigators and mentors, the students will deepen their knowledge of how applied Engineering & Scientific Computing advances designs of physical systems. The direct cooperation between the Swedish and US scientists who will supervise the students’ research will rapidly disseminate knowledge about high-order accurate, and reliable computing processes that are optimized for high-performance computer architectures.

Students will internalize the knowledge, skills, and attitudes necessary to operate effectively in an interconnected changing world of diverse ethnicities, religions, languages, institutions, and cultures. Through these experiences, the students will develop skills and international attitudes to adapt their behavior to interact effectively with those who are culturally different from them, interpret issues and situations from more than one cultural perspective, accept cultural differences as well as manage cultural ambiguity, seek out international or intercultural opportunities, and use diverse cultural frames of reference and alternative perspectives to think critically and solve computing problems that transcend national boundaries.

By living in a different country and culture, the participants will also sharpen their interaction, resilience, and resourcefulness skills in navigating distinct cultures, expectations, and processes. These transferable skills are highly valued by employers and multinational corporations such as Boeing and Saab, which extensively use computational simulations. In order to continue to deliver services and products to their markets and sustain local economies, these corporations need to engage globally educated and multi-culturally oriented professionals, who have had personal direct experiences with the cultures of these corporations’ home and host countries. These benefits to local economies are realistic not only for the U.S., but also for Sweden in view of the multitude of U.S. and Sweden corporations that successfully operate in both countries.
Student Eligibility Requirements
For a successful completion of the research projects in this program, the needed background is the knowledge that is normally acquired by students in the following majors:

- Computer Science
- Data Analytics
- Engineering: Biomedical, Civil, Chemical, Electrical, Mechanical, Software
- Mathematics
- Physics

Independently of a major, the eligibility requirements for all applicants are:

- US citizenship, nationality, or permanent residence (required by NSF)
- WSU undergraduate standing
- enrollment in a STEM field related to Engineering & Scientific Computing, such as the fields listed above
- an overall cumulative GPA of at least 3.0
- a cumulative GPA of at least 3.0 in any courses on Computer Programming, Linear Algebra, and Differential Equations
- one or preferably two semesters remaining prior to graduation by the end of the exchange semester in Sweden

Students who will have completed any courses in Numerical Analysis and Partial Differential Equations by the beginning of the semester in Sweden will have a particularly competitive application.
Application Documents (Combined in one single PDF file)
1. Evidence of US citizenship, nationality, or permanent residence (required by NSF)
2. Resume and WSU transcript
3. List of remaining courses prior to graduation, endorsed by the applicant’s academic advisor
4. Name and contact information of a professor who taught the applicant a computing related course and who is willing to provide a recommendation letter discussing the applicant's technical skills and potential for research success
5. Two-page max single-spaced motivation letter to describe:
   • career goals
   • rationale to conduct computing research in Sweden
   • any prior experience with research, internships, international education
   • any prior experience with scientific computing
   • any prior experience with computer programming
   • any prior experience with languages and cultures other than American

Timeline
• Student recruitment during fall ’23 semester
• Submit 2 related applications in parallel as follows:
  o application 1 to be completed with International Programs, for the foundational study-abroad semester at LiU, due no later than March 1, 2024
  o application 2 to be completed with WSU Europe, for this integrated program with the $12,000 fellowship, due no later than December 20th, 2023
• 7 IRES scholars selected by middle of January 2024
• First Zoom meeting by end of January '24 between IRES scholars and WSU program director to discuss overall program organization and travel
• Second Zoom meeting by end of second week of February '24 between IRES scholars and program director to discuss research preparation and expectations
• Third Zoom meeting by end of February '24 between IRES scholars, program director and program managers at LiU to discuss research projects and logistics of stay in Sweden
• Scientific Computing Preparatory Zoom Workshop during first two weeks of June '24
• Departure to Sweden by the second week of August '24
• Residence in Sweden during the following fall semester '24
• Submittal of technical report and completion of survey by end of fall '24
• Return to the U.S. at end of fall semester

Questions
For questions or further information, please communicate with Dr. Joseph Iannelli (VCEA).