PROGRESS REPORT: 2011-2012

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Research Description

My primary goal is to lead the effort to provide the mathematical and computational infrastructure that will transform the way we compute with partial differential equations by making Abelian functions as computationally accessible as trigonometric and hyperbolic functions thereby providing to the scientific community an essential ingredient in finding large families of solutions to partial differential equations arising in a variety of fields including plasma physics, nonlinear optics, and water waves.

Research Update

I spent most of this academic year building the computational framework to my software package "abelfunctions", a Python-based library for computing with Abelian functions. The code is hosted at the online code repository website, Github, (`https://www.github.com/cswiercz/abelfunctions`), where other researchers can freely browse and contribute to the source code. The decision to host the code here is in line with the proposals discussed at the ICIAM 2011 satellite meeting on reproducible research as well as in support of the open-source software community.

I have also expanded my network of collaborators. Last academic year and during the Autumn quarter of this academic year I presented my work at several conferences throughout the United States and at international conferences in Edinburgh, UK and Olso, Norway. From these conferences I've initiated collaborations with Harry Braden at the University of Edinburgh and Ondřej Ceřtík at the University of Reno. This collaboration will lead to a more robust, fully featured software library.

Presentations and Coursework

In October of this academic year I presented a talk titled "Some Computational Problems Using Riemann Theta Functions in Sage" at the AMS Fall Western Sectional Meeting in Salt Lake City and at the SIAM Conference on Applied Algebraic Geometry in Chapel Hill. This talk became the basis of a paper "Computing Riemann theta functions in Sage with applications", coauthored with Bernard Deconinck, that was submitted for publication at the end of 2011.

My coursework for this quarter includes a three-quarter algebraic geometry sequence offered by the Mathematics Department and a course on general purpose GPU programming course offered by the Mechanical Engineering Department. Algebraic geometry lies at the heart of some of the theory of Abelian functions. Although much is accomplished when considering only the "classical" theory, a background in modern algebraic geometry will allow me to take advantage of any useful tools in the field I may encounter. The course in general purpose GPU programming deeply enriched my computational skills and will allow me to develop much faster implementations of algorithms related to Abelian functions.

Expected Academic Schedule

I expect to complete my general examination by the end of 2013 and complete my degree by the end of 2015.