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Research Statement

My research interests include software architecture, software engineering, software testing, statistical behavioral analysis of software systems, and model-driven architecture. The theme of my research is the scientific exploration of software development processes with the twin goals of improving how we model problems and of improving how we implement computer-based solutions.

My current research focuses on developing and implementing formal methodologies for the large-scale management of data and analysis artifacts generated in the earth sciences. To that end, I founded and direct Cyber Infrastructure Research and Development Lab for the Earth Sciences (CIRDLES,) funded as a sub-award to a NSF-funded project directed by J. Douglas Walker of the University of Kansas, entitled "Collaborative Project: Facility Support: EarthChem - Advancing Data Management in Solid Earth Geochemistry."

CIRDLES collaboratively integrates domain-specific software engineering with the efforts of two NSF-supported initiatives: EARTHTIME and EarthChem. EARTHTIME's goal is the unification of the different approaches to data acquisition and processing, and EarthChem's goal is the creation of data repositories for all geochemical data. The first project for CIRDLES is the design and implementation of an exemplar end-to-end data processing system for uranium-lead geochronological data that will link data production to data archiving. This system will be the template for subsequent efforts to process all geochronological data such as other radioisotopic systems involving $^{40}\text{Ar}/^{39}\text{Ar}$, U-Th-He, and Lu-Hf.

The software produced by this project is an open-source program, called *U-Pb_Redux*, that supports the geochronological analysis of samples and their constituent minerals and the subsequent publication and retrieval of the analysis results from the EarthChem database. The software brings an unprecedented level of quality and transparency to geochemical data processing. *U-Pb_Redux* features transparent data reduction and uncertainty-propagation with visualizations; XML-based data handling; and publication-quality data tables and Concordia diagrams.

CIRDLES also provides jobs and internships for undergraduates. Details are located at: <https://cirdles.cs.cofc.edu> .