NASA SBIR/STTR Technologies

S6.03-9468 - A Rapid Model Fitting Tool Suite

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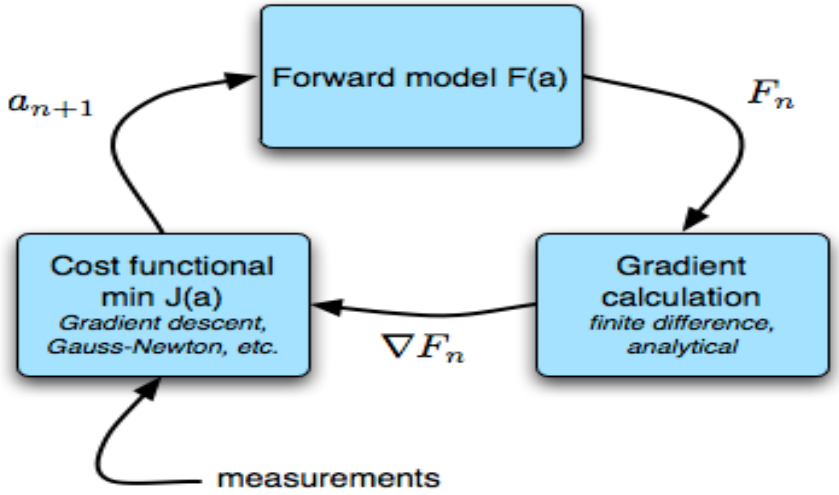
Identification and Significance of Innovation

An integral component of many NASA missions involves remote sensing of the environment, both terrestrial and celestial. This is a challenging problem, since quantities of interest typically can not be directly measured but instead must be inferred. These inferences are made by solving inverse problems, where complex forward models are inverted to estimate parameters of the model. These parameters correspond to physical properties of the environment. Because of the complexity of many forward models, inversion is usually accomplished by minimizing the difference between observations and model predictions through adjustment of model parameters. This minimization process is computationally demanding, since it requires evaluating the forward model many times and minimizing a function of many variables.



Estimated TRL at beginning and end of contract: (Begin: 4 End: 7)

Technical Objectives and Work Plan

Objective 1. Improve performance of NASA codes such as SAGE III line-by-line calculations.
Objective 2. Demonstrate a GPU accelerated general-purpose Levenberg-Marquardt fitting routine implemented in C.
Objective 3. Demonstrate GPU accelerated curve fitting from within the IDL environment.

Task 1: Perform optimization of CPU line-by-line code from SAGE III Task 2: Migrate line-by-line code from SAGE III to GPU and perform further optimizations Task 3: Generalize line-by-line code for use with other NASA projects Task 4: Develop a GPU accelerated general-purpose Levenberg-Marquardt algorithm task 5: Make general-purpose GPU accelerated curve fitting routine available from IDL Task 6: Develop a mechanism for runtime GPU kernel creation for evaluation of mathematical expressions Task 7: Make runtime kernel creation accessible from within IDL Task 8: Reporting

NASA Applications

Because of the widespread use of optimization techniques in parameter estimation, the software developed in this project will be used extensively by NASA scientists working on present and future missions. Moreover, with the increasing amounts of data to be processed, hardware accelerated optimization software will provide a valuable, time-saving tool to NASA scientists. Missions that will directly benefit from the proposed software are SAGE III, SDO and Glory, to name a few.

Non-NASA Applications

Parameter fitting is a general capability used across many disciplines. The parameter fitting software resulting from Phase I will be incorporated into GPULib. GPULib interfaces to IDL, which is used extensively in astronomy and earth sciences, disciplines focused on data analysis/reduction which rely heavily on curve fitting.

Firm Contacts

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NON-PROPRIETARY DATA