NASA SBIR # NNX11CH10P

NASA SBIR/STTR Technologies

A Rapid Model Fitting Tool Suite

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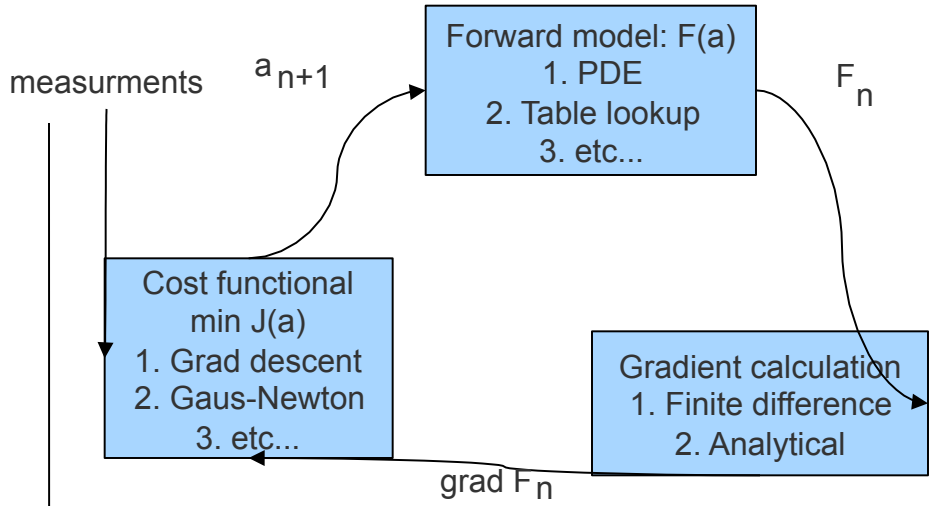
Identification and Significance of Innovation

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 cannot 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.



Expected TRL Range at the end of Contract: 3-4

Technical Objectives

- ***Demonstrate the feasibility of a parameter fitting framework on GPUs.***
- ***Demonstrate performance benefits of using GPUs for parameter fitting problems.***

Work Plan

Task 1: Prototype two forward models on GPUs
Task 2: Prototype a GPU finite difference gradient operator
Task 3: Prototype Levenberg-Marquardt minimization on a GPU
Task 4: Analyze performance benefits of GPU accelerated optimization

NASA and Non-NASA Applications

NASA Applications:
The software tools in this project can benefit a variety of current NASA missions including the Landsat Continuity Mission (LDCM), or planned missions like HyspIRI, the hyperspectral infrared imager. This is not only a challenge encountered with Earth Science missions, but with all future missions, including the Solar Dynamics Observatory or the James Webb Space telescope. Mechanisms currently used or investigated to reduce the amount of data prior to transmission to Earth ranges from fairly simple trigger functions as encountered on board of RHESSI or planned or XMM, to more complex cloud detector algorithms on board the Earth Observing System (EOS) mission.

Non-NASA Applications:
Modern computational accelerator technologies like FPGAs and GPUs can be difficult to program efficiently and effectively due to the complex nature of the underlying hardware. Many companies provide libraries with highly specialized algorithms that can be accessed from compiled languages like C/C++/Fortran. However, this presents another barrier for many scientists who generally program in high-level languages like IDL. The tools developed in this project, can make these computational accelerators easily accessible to a much wider range of scientists through open source high level languages.

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NON-PROPRIETARY DATA