**SASI: Smart Algorithm Selection Through Inference**

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**Market Opportunity**

Numerical simulation is an essential step in the design pipelines of almost every modern technology or product, ranging from finite element stress-testing on $2 polycarbonate trinkets through to the high-fidelity, high-impact and high-resolution simulations informing the design of production grade nuclear reactions. For solving the problems occurring at various stages of numerical simulations, typically there are numerous algorithms and implementations for the task. While much work has taken place in optimizing the algorithms and implementations for specific problems and architectures, there is no simple governing theory for choosing between the numerous algorithms and configurations. Rather, the optimal method is, in practice, determined by experimentation and numerical folklore

To address this need, RNET and the University of Oregon are proposing the Smart Algorithm selection through Inference (SASI) framework. SASI will be a generic toolkit that guides the user through the process of building and using smart algorithm selection models in modern numerical simulations. SASI provides developers with a mechanism for allowing the problem and architecture to determine the optimal solver, removing the need for time consuming parameter tuning. Ultimately, SASI will allow developers to ship tools that run optimally on any architecture, speeding up development across the entire design pipeline; from early stage testing on single desktops through to final exascale production runs.

The idea for SASI was born out of the ideas, lessons and workflows developed during the project teams previous work on automatic solver selection for linear solvers, eigen-solvers and graph algorithms. That previous work has continuously shown that SASI style performance models were capable of repeatedly predicting, with an extremely high accuracy (i.e., 98\%+), the performance of numerical algorithms and solver configurations across a wide range of applications and domains.

The end users of the tool are the numerical software developers, computational scientists, CFD developers, and the wider computational community in government agencies such as DoD, NASA, and DOE. The targeted customers include independent CFD software providers, oil and gas companies, semiconductor design companies, and prime contractors of DoD organizations (e.g., AFRL, Boeing, Lockheed, etc.).

SASI will be released as a restricted open source software wherein a license is required to use SASI in a commercial product. Most of the revenue is expected to come from training, support and integration contracts. Open source commercialization models are quickly becoming the norm in the numerical simulation community, primarily because it appeals to a user-base that almost exclusively deals in free software. In return, the results, papers and simulation toolkits released utilizing SASI models act as free, no-cost marketing for SASI, further driving uptake of SASI while also increasing the likelihood of obtaining new service contracts.

**Intellectual Property**

To protect our Intellectual Property (IP), we will use “Trade Secrets”, which will allow RNET to protect the underlying technologies and process used for product development. Trade secrets can make copying some technologies more difficult. However, some IP may have to be protected via patents in order to establish a competitive advantage. If a need for patents arises, we will employ the services of well-known patent law firms in Dayton, OH, and in Columbus, OH. The innovation for which we may want to write a patent application include the technologies for phase detection, the classifiers with varying levels of complexity, and the usage of uncorrelated features for solver selection.

**Company/Team**

RNET Technologies (i.e., RNET), located in Dayton, Ohio, was founded in June 2003 as a “C” Corporation organized under the laws of the State of Delaware*.* The relevant RNET technical team members are described below. Professor Norris is an essential member of the team and is described in the subcontractor section of the technical proposal. Professor Norris will serve as an adviser for this product.

Dr. V. Nagarajan (RNET President), who has an MBA with specialization in Marketing, will develop the marketing and the commercialization plan for the product that will be developed in this project. He has over twenty years of executive and senior management experience. At RNET he is spearheading the effort to commercialize the SmartNIC, the rad-hard ULP FPGA and the ROICs.

Dr. Ben O’Neill is a key member of RNET’s technical team and has significant HPC research experience. Currently he is working as a the lead developer for RNETs ongoing SBIR Phase II ward developing an automatic algorithm selection model the linear solvers used in nuclear engineering simulations and is the PI on a DOE Phase I SBIR project developing a verification and validation toolkit for the nuclear engineering community. Ben is also the lead developer on RNETs Cloudbench project developing a collaborative, web-enabled workflow and provenance manager for large scale numerical simulations and was the PI on the recently concluded SBIR Phase I VERA Workbench project, developing a custom interface for VERA input files. His background in HPC computing and his experience with automatic solver selection in linear solvers makes him highly qualified to serve as PI for this project.

Dr. Gerald Sabin, Project Manager at RNET, is another key member of RNET’s technical team. Currently, he has worked on several HPC SBIR/STTR projects (DE-FG02-05ER-84163, DE-FG02-08ER-86360, DE-SC-0002182, DE-SC0004510, DE-SC0002182, DE-SC0009520, and others) at RNET, and has strong expertise in software development. His bio-sketch provides a more detailed list of the relevant projects he has been working on.

**Revenue Forecast**

RNET estimates that the total sales revenue will be $3M and total licensing revenue will be $2M during the first 10 years of commercialization. These numbers are preliminary estimates and will be refined with help from Larta during Phase I. The Phase II commercialization proposal will include updated revenue figures.