AWESIM: A PLATFORM FOR WEB-BASED HPC APPLICATIONS

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ABSTRACT

AweSim is the next logical step to advance the “Blue Collar Computing” initiative launched by the Ohio Supercomputer Center (OSC) and its partners in 2004, to help lower the barriers to entry for high-performance computing (HPC) based modeling and simulation (M&S). This initiative is designed to simplify the use of advanced simulation-driven design with integrated point-and-click apps to dramatically lower the cost of such simulations. AweSim uses four key technologies: (1) advanced models for manufacturing processes with material properties, (2) a simple web-based user interface, (3) cloud-based computing resources and (4) computational solver software. Previous related work, funded by the Departments of Energy and Commerce, the National Digital Engineering & Manufacturing Consortium (NDEMC), and OSC’s industry partners, has received numerous recognitions.

Using this platform, OSC and its industry partners are together pioneering the field of M&S as a Service (M&SaaS) – automating the manual prototyping process and creating reusable apps to support affordable and accessible HPC modeling, simulation and analysis for manufacturing. The platform provides the tools to rapidly develop customized M&S tools (known as apps), which in turn will enable small- and medium-sized manufacturers (SMMs) – the primary end users targeted for this effort – to develop better products more quickly to address emerging customer requirements. The existing platform capabilities include OSC’s HPC facilities; the prototype App Kit (reduces time required to write new apps); the prototype App Runtime (supports execution of apps at HPC and cloud computing providers); prototype apps (demonstrate proof of concept); M&S and software expertise; and a training infrastructure.

The App Kit in particular is a multilayer architecture consisting of a web access layer, a web application layer and a system interface layer. The web access layer uses OpenID for integrated single sign-on authentication with the App Store and industry-standard Apache and Apache-based web proxy services. The web application layer is built on industry-standard technologies. In addition, the web application layer contains reusable app templates created from OSC's experience in app creation. Finally, the system interface layer provides direct access to local resources such as databases, file systems and HPC job queues. App Kit restricts users to running their apps within individual workspaces, which simplifies app design by moving authentication out of the web application layer. These features greatly reduce the time to develop an app.

OSC and its collaborating Ohio client companies are generating a number of innovations in this three-year project to: convert the prototype App Kit and App Runtime software into commercial products; rapidly develop new apps in high demand by Ohio manufacturers; create a commercial, self-sustaining and growing infrastructure based in Ohio to make these and future apps widely available via an e-commerce App Store; and train users to effectively use the apps. Initial high-demand apps identified by Ohio industry are in the areas of advanced materials, agribusiness and food processing, and medical technologies.

For example, the award-winning Weld Predictor app, developed by OSC in collaboration with EWI, incorporates the specifications required for a detailed simulation of a gas-metal arc weld including the geometry, material properties and welding procedure. The simulation results provide information on heat distributions, weld strengths and microstructure properties. EWI estimates that using legacy methods, such simulations would require a doctorate-level expert in finite element analysis to spend 12 man-hours on setup and six months on overall project completion time. With Weld Predictor, the same simulation could be run by a baccalaureate-level engineer with one man-hour of setup and 1 month overall project completion time.