Comparison of User Vs. COMSOL® Developed Automated Installation Verification of COMSOL Multiphysics® Software

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Abstract

For any computer code, some sort of installation verification is desirable each time it is installed on a computer. Installation verification is the process of 'verifying' that a new code installation performs as the code developers intend. In many commercial applications this is not only desirable but required, particularly when the results from a particular code installation can affect human safety or commerce. Because of this, many commercial codes perform a self-verification immediately after installation. This results in precise, consistent, and efficient installation verification for the end users which builds confidence in the code and its results. For codes which do not currently offer this functionality, each end user is left to perform their own installation verification when required, leading to imprecision, inconsistency, and inefficiency, and ultimately less confidence in the code itself.

We have previously addressed this issue via user-generated MATLAB® scripts which utilize the LiveLink™ for MATLAB® functionality to perform consistent automated installation verification [1]. The 'Model Tester' and 'Test Generator' of the COMSOL Multiphysics® software, which enable very similar automated installation verification from within a COMSOL® application. In this work we have compared the functionality and performance of both approaches and found them to be largely equivalent, but with some tradeoffs. Both methods compare a previously stored model solution with one generated via the current installation and compute a comprehensive relative difference metric which includes all model nodes, time-steps, etc. Figure 1 shows an example of a relative difference metric computed over the entire domain of the 'naca0012 airfoil' model, and Figure 2 shows the worst case relative difference calculated for a suite of models. These examples would be intractable to compute by hand and illustrate the need for an automated approach to verification. As expected, the COMSOL® applications are generally more user friendly but less flexible than our user generated scripts. However, given their current performance, with continued development we expect the COMSOL® applications to outperform the user generated script option for the vast majority of installation verification needs.

It should also be noted that the same applications/scripts can be easily adapted for not just verification, but also validation tasks wherein the applicability of a code/model to a given type of problem is established. Therefore, the new features of the COMSOL Multiphysics® software, 'Model Tester' and 'Test Generator' applications represent a significant advantage for COMSOL® users, and especially those whose applications specifically require verification and/or validation.

Reference

[1] MW Crowell, 'Automated Installation Verification of COMSOL via LiveLink for MATLAB', Proceedings of the 2015 COMSOL Conference in Boston, (2015)
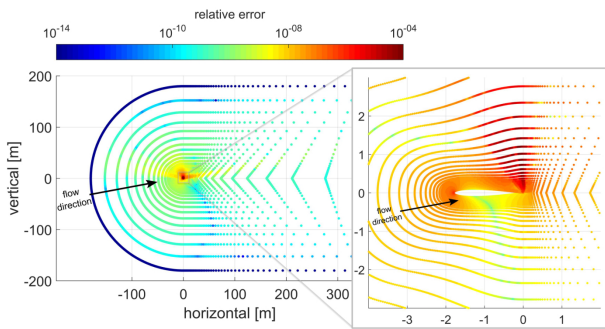
Figures used in the abstract

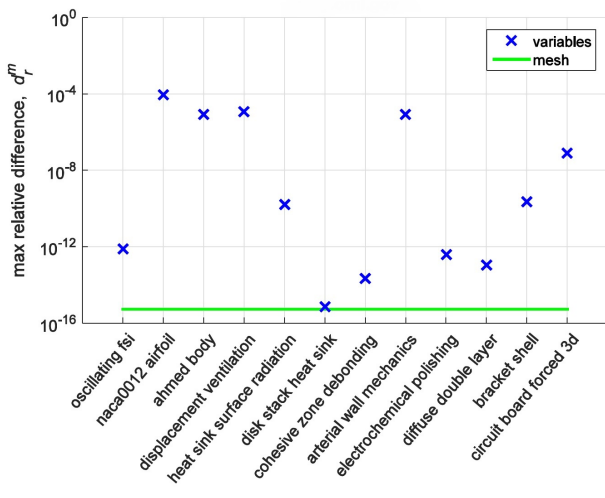**Figure 1**: Vertical flow velocity relative differences for the 'naca0012 airfoil' model

Figure 3: Relative differences for selected models