

INTRODUCING A NEW CLIENT-SERVER FRAMEWORK FOR LARGE CFD MODELS

ANDREA PARONI¹, PAOLO GEREMIA², STEFANO VALERI³

¹ENGYS SRL, Trieste Italy, a.paroni@engys.com

²ENGYS SRL, Trieste Italy, p.geremia@engys.com

³ENGYS SRL, Trieste Italy, s.valeri@engys.com

Keywords: HELYX[®], OpenFOAM[®], client-server, rendering

HELYX[®] is a complete Computational Fluid Dynamics (CFD) professional solution which combines an enhanced version of OpenFOAM[®] with a Java-based graphical user interface developed by ENGYS. HELYX[®] combines the benefits of an open-source solution, such as high scalability and cost efficiency, with the advantages of a professional solution in terms of quality and usability.

In this context, one the main limitations of the current technology for handling large CFD simulations on different IT environment is the data size and transfer to the front end machine back and forth to the HPC cluster machine. In addition to this, data visualization of CFD simulations currently represents a bottleneck for the designer in particular when the size of the simulation is prohibitive and when the data resides on a remote network infrastructure. This works deals with the development of an efficient client-server architecture to overcome the main limitation of the current HELYX[®] interface.

The client/server architecture detailed here was designed to improve the user experience by avoiding the transfer of visualisation data from the remote machine to the local one prior to perform the rendering process. In order archive this aim, two new components which operate separately without any mutual dependence were introduced: HELYX[®] Server and HELYX[®] 3D Server. The main purpose of the HELYX[®] Server component is to handle the simulation from the data perspective whereas the HELYX[®] 3D Server component is responsible for the rendering process.

The new client/server tool covers two of the main end-user application scenarios, namely rendering performed on machines that have a hardware-accelerated graphical environment (GPU) available and rendering on machines without display capabilities such as compute nodes on HPC clusters. For this purpose, the OpenGL[®] 2[1] backend is employed for the GPU rendering case, whereas the llvm-pipe is used for the software rendering[2]. In order to obtain acceptable performance for the 3D rendering component, HELYX[®] exploits a customized VTK[®] component which merges the high level performance offered by the Kitware vanilla VTK[3, 4] with CFD specific requirements.

One of the most important considerations during the development was the assurance of enterprise level data integrity. For this reason, the client/server version of HELYX[®] was developed in order to minimise the volume of the simulation data transferred through the network. Security is further enhanced through the use of SSH-tunnelling and the integration of a high efficiency RFB[5]-derived protocol for the minimisation of latency and data traffic volume.

References

- [1] OpenGL. (2016) Opengl - the industrys foundation for high performance graphics. [Online]. Available: <https://www.opengl.org>
- [2] E. Miretsky, "Software based gpu framework," Ph.D. dissertation, 2013.
- [3] D. DeMarle, B. Boeckel, and C. Atkins. (2016) Vtk 7.0.0. [Online]. Available: <https://blog.kitware.com/vtk-7-0-0/>
- [4] Kitware. (2016) Vtk/api changes 6.3.0 to 7.0.0. [Online]. Available: http://www.vtk.org/Wiki/VTK/APIChanges_6.3.0_to_7.0.0
- [5] T. Richardson and K. R. Wood, "The rfb protocol," *ORL, Cambridge, January*, 1998.

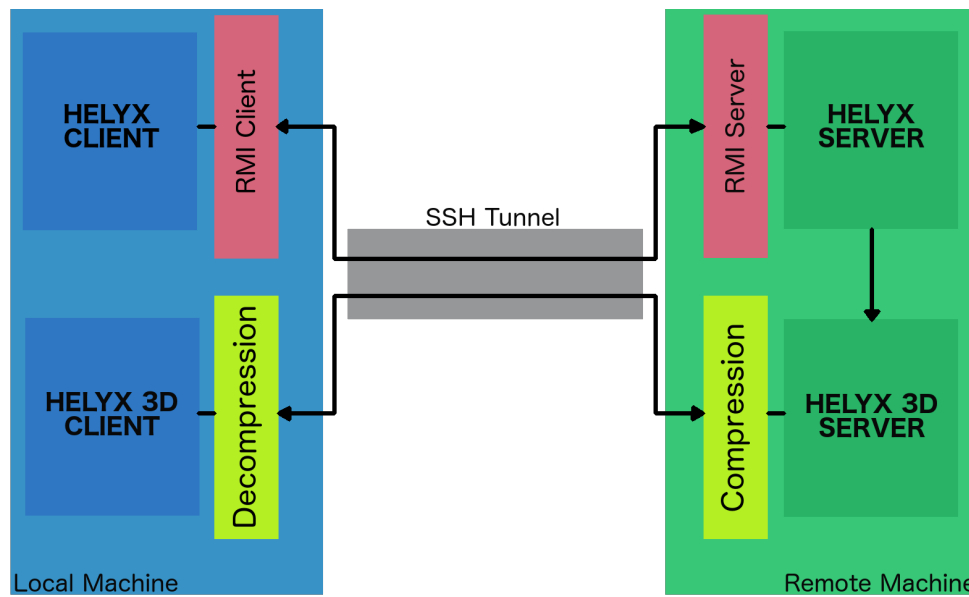


Figure 1: The figure shows the new HELYX[®] release architecture. Two new components has been introduced: HELYX[®] Server and HELYX[®] 3D Server. Streams of compressed graphical buffers are moved through the network in a SSH-tunnel.