The use of virtual prototypes and digital models containing thousands of individual objects is commonplace in complex industrial applications like the cooperative design of huge ships. Designers are interested in selecting and editing specific sets of objects during the interactive inspection sessions. This is however not supported by standard visualization systems for huge models.

In this paper we discuss in detail the concept of rendering front in multiresolution trees, their properties and the algorithms that construct the hierarchy and efficiently render it, applied to very complex CAD models, so that the model structure and the identities of objects are preserved. We also propose an algorithm for the interactive inspection of huge models which uses a rendering budget and supports selection of individual objects and sets of objects, displacement of the selected objects and real-time collision detection during these displacements. Our solution---based on the analysis of several existing view-dependent visualization schemes---uses a Hybrid Multiresolution Tree that mixes layers of exact geometry, simplified models and impostors, together with a time-critical, view-dependent algorithm and a Constrained Front. The algorithm has been successfully tested in real industrial environments.

http://dx.doi.org/10.1016/j.cad.2016.06.005