Enabling Accelerated Boundary-element Design Tools for Packaging and Interconnects

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For today's high-speed, high-density electrical packaging, while analysis tools based on boundary element methods are particularly efficient due to the development of fast algorithms that solve these matrix equations in near linear time, the need for design tools has not been met. For boundary element methods, such a tool would necessitate the ability of incremental solution, wherein small changes in designs would not require a complete simulation pass. The development of such a design tool is rendered more challenging because boundary element methods, solved by method of moments techniques, lead to full matrices. Changing the location or design of a component would alter entire rows and columns of these matrices, and therefore increase even the setup cost linearly.

A novel approach to localize the effects of incremental design of spatially separated components within the method of moments is presented. The technique proceeds by isolating the component under design in a closed mathematical surface. This surface bifurcates the overall simulation problem: the interior problem includes the interaction of the component and its surface, and the exterior problem is related to the surface and the remainder of the global problem. The overall gain of this method is that the setup cost is only related to the local problem of the component, the surface, and the interaction between these two. Moreover, for direct solvers, a Schur-complement based scheme can also accelerate subsequent solves, by presenting the remainder of the matrix in a factorized form as a numerical Green's function for the localized problem.