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Development of a general SEA subsystem formulation using FE periodic structure theory

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Statistical Energy Analysis (SEA) represents a field of study in which statistical descriptions of a system are employed in order to simplify the analysis of complicated vibro-acoustic problems. In SEA, a vibro-acoustic system is represented by a collection of subsystems that can receive, store, dissipate and transmit vibro-acoustic energy. Traditionally, the SEA parameters for a given subsystem are formulated analytically based on consideration of wave propagation through the subsystem. While such analytical algorithms can be readily applied to the majority of systems encountered in practical problems, there are certain types of sections that are difficult to describe using existing analytical formulations. Examples include: isogrid in launch vehicle fairings, extruded aluminum sections in train floors and modern corrugated aircraft fuselage constructions. This paper describes the development of a generic SEA subsystem formulation based on the use of Finite Element (FE) periodic structure theory. A small unit cell of the section is created and computationally efficient algorithms are developed to calculate wave propagation through a large array of such cells. The resulting algorithms are used to calculate the SEA parameters for the section. The approach is described and a number of numerical validation examples are presented.