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Acoustic Modeling of a Data Center with a Hot Aisle Containment System

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Abstract : A new multi-physics acoustic modeling approach using ANSYS Mechanical FEA and FLUENT CFD methods is developed for modeling servers mounted to racks, such as IBM Z and IBM Power Systems, in data centers. This new approach allows users to determine the thermal and acoustic conditions that people are exposed to within the data center. The sound pressure level (SPL) exposure for a human working inside a hot aisle containment system inside the data center is studied. The SPL is analyzed at the noise source, at the human body, on the rack walls, on the containment walls, and on the ceiling and flooring plenum walls. In the acoustic CFD simulation, it is assumed that a four-inch diameter sphere with monopole acoustic radiation, placed in the middle of each rack, provides a single-source representation of all noise sources within the rack. Ffowcs Williams & Hawkings (FWH) acoustic model is employed. The target frequency is 1000 Hz, and the total simulation time for the transient analysis is 1.4 seconds, with a very small time step of 3e-5 seconds and 10 iterations to ensure convergence and accuracy. A User Defined Function (UDF) is developed to accurately simulate the acoustic noise source, and a Dynamic Mesh is applied to ensure acoustic wave propagation. Initial validation of the acoustic CFD simulation using a closed-form solution for the spherical propagation of an acoustic point source is performed.

Keywords : data centers, FLUENT, acoustics, sound pressure level, SPL, hot aisle containment, IBM
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