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# Simulation of vehicle interior wind noise at low frequencies: a case study

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Quietness of passenger vehicle interiors has become a critical-to-quality metric in designing modern passenger vehicles. At the same time, the necessity of bringing fresh designs to market quickly has greatly compressed the development time available to achieve the desired refinement of interior noise and vibration. This has forced manufacturers to place increasing responsibility on analytical simulations in developing countermeasures for noise problems. One aspect of car acoustics that has not received very much attention from the simulation community is the wind noise created by external air flow at speed. Significant contributions to interior loudness can come from underbody air flow, while improvements in simulation efficiency of Computational Fluid Dynamics (CFD) flow models and Finite Element Analysis (FEA) vehicle vibration and acoustic models now make it feasible to analytically simulate interior noise caused by wind excitation. This lecture describes a case study where existing vehicle models were adapted to first build a wind load case from CFD, and then to apply it in estimating and reducing interior noise in FEA. Topics to be covered include: spatial discretization of continuous panel pressures, application of random loads to deterministic vehicle FEA models and diagnostic imagery for visualizing noise and vibration responses.