ANALYTICAL TOOL DEVELOPMENT FOR AFTERTREATMENT SUB-SYSTEMS INTEGRATION

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ABSTRACT

The stringent emissions standards of 2007 and beyond require complex engine, aftertreatment, and vehicle systems with a high degree of subsystem interaction and flexible control solution. This necessitates a system-based approach to technology development, in addition to individual subsystem optimization. Analytical tools can provide an effective means to evaluate and develop such complex technology interaction as well as understand phenomena that are either too expensive or impossible to study with conventional experimental means. The analytical effort can also guide experimental development, and this lead to efficient utilization of available experimental resources.

A suite of analytical models has been developed to represent particulate matter and NO_x aftertreatment subsystems. These models range from computationally inexpensive zero-dimensional models for real-time control applications to computational fluid dynamics (CFD)-based multi-dimen-sional models with detailed temporal and spatial resolution. Such models, in conjunction with well-established engine-modeling tools (such as engine-cycle simulation, engine controls modeling, CFD models of non-combusting and combusting flow, and vehicle models), provide a comprehensive analytical toolbox for complete engine, aftertreatment, and vehicle subsystems development and system integration applications. However, the fidelity of aftertreatment models and application going forward is limited by the lack of fundamental kinetic data.