

# MAE Seminar SERIES

THURSDAY,  
OCTOBER 17  
3:30 PM  
KNOX 14



**Dr. Raymond Kach**

Product Development Engineer

Ford Motor Company

Powertrain Applications

## TRIALS & TRIBULATIONS USING 1D ENGINE PERFORMANCE SOFTWARE FOR NVH

### ABSTRACT

Prior to the development of the development of 2nd order schemes in the early 1980s, the 1st order method of characteristics was used for engine performance analysis. In addition, to drive the design of vehicle exhaust systems and air induction systems, acoustic methods were used to improve the acoustic transmission/insertion losses to reduce the pressure waves emanating from the engine intake or exhaust manifolds. For both of these cases the assumption was that the pressure waves were sufficiently small that linear techniques could be used.

In reality the pressure waves in both the exhaust system and air induction system fall in the large wave category and therefore are non-linear. The advent of 2nd order numerical techniques to solve the 1D wave dynamics equation permitted the application of engine performance simulation software to intake/exhaust noise prediction in addition to engine performance.

This presentation briefly explains the benefits of 2nd order numerical techniques vs 1st order numerical techniques for solving the 1D wave dynamic equations along with several examples of how 3D duct are physics captured in 1D.

Examples are provided showing how best to model in 1D duct end effects and bends in order to capture their effects on wave dynamics. Also, an example of using the 1D engine simulation software to drive basic engine intake manifold design for improved sound quality and an actual design example are also provided.

### BIO SKETCH

Dr. Raymond Kach is currently working at the Ford Motor Company in the Powertrain Applications organization. Dr. Kach started working at Ford Motor Company in Engine Research in 1979 after receiving his MS in Mechanical Engineering. He received his Ph.D. from the University of Michigan in 1988. Dr. Kach received his BS in Mechanical Engineering from the University at Buffalo in 1977.

Throughout his career at Ford Dr. Kach has been involved in Engine Simulation, both developing the capabilities as well as driving engine design. Dr. Kach was involved in driving engine simulation to be an integral part of engine design concepting and development. Today, engine simulation is considered an integral tool supporting engine target setting and development for new engine programs. In addition, Dr. Kach has helped drive the use of 1D Engine Simulation Tools for engine induction and exhaust system development earning him the 2018 SAE Ralph K. Hillquist NVH Lifetime Achievement Award.

Dr. Kach has also supported Formula 1, NASCAR and CART engine development.



University at Buffalo

Department of Mechanical  
and Aerospace Engineering

School of Engineering and Applied Sciences