1. SUMMARY

This lecture will provide a detailed look at transient engine simulation methodology; that is, the specific steps that are taken in the creation of a transient engine simulation program. It will cover the types of models used in a transient engine simulation, the methods by which these models are implemented in the simulation, and the process by which the simulation is used to generate useful data.

2. INTRODUCTION

The transient engine simulation process begins with the definition of a mathematical model. The model's content is determined from an analysis of the requirements that will be placed on the simulation program. This lecture is intended to describe various methods by which the model is implemented as a simulation program. It will cover linear and nonlinear methodology and will concentrate on those aspects of simulation methodology that go to the basic nature of digital simulation, rather than the secondary differences between linear and nonlinear methods. Several useful formulas and transforms are presented. Finite element methodologies that are thought to applicable to the next generation of engine simulation are discussed. Finally, facilities that have been found to be useful to the simulation process are described.

3. REQUIREMENTS

The model selection process does not occur in a vacuum. It depends on a full understanding of the kinds of things for which it will be used and an appreciation of the relative difficulty that the model presents to the program developer. These two factors combine to form overall requirements for the simulation.

Simulation requirements have, in the past, been rather nebulous. As we experimented with various techniques, our understanding of both simulation's capabilities and its requirements increased. The practice has become more standardized, at least insofar as numerical methodology is concerned, and expectations can now be more accurately defined.

Simulation requirements grow out of the interaction between two related questions, "What should the simulation be able to do?" and "How should the simulation do it?" The process of drafting requirements should be directed at the identification of all the answers to the first question and the assurance that adequate means exist to successfully execute each of them.

I feel that at least half of the effort directed toward the creation of a new simulation capability should be used to define requirements. This must include contributions from each party that will take part in the process, an integrated, accessible requirements document and, most importantly, well-defined leadership.