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FINITE ELEMENT VERSUS FINITE VOLUME - REMEMBERING BRIAN SPALDING

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ABSTRACT

In my early days of CFD model development, I spent many hours reading about the fluids modeling efforts of Brian Spalding and his students, A. K. Runchal, S. V. Patankar, A. D. Gosman, and M. Wolfshtein. Their work, under the tutelage of Brian, essentially exploded the application of computational fluid dynamics and made the solution of the Navier Stokes equations actually feasible. The implementation of the finite volume technique for discretizing these nasty, highly nonlinear equations of fluid motion, and especially combustion processes, were insightful, and created interesting and exciting solutions (even the non-real ones). My first interaction with Brian, and later with many of his legacy students, began in the mid 1970's, and I became even more adamant about exploring CFD after listening to one of his talks at a conference – he made modeling fluid flow seem so straightforward. Later, when I begin to venture into finite elements (or as Brian would tell me – the dark side of CFD), I began to appreciate even more the magnitude of his work and creativity, and using his work to verify and justify our efforts to employ an alternative numerical method. Over the ensuing years, we would have friendly jousts about finite element versus finite volume (especially during conference presentations). Some years ago, when I introduced the use of meshless methods in lieu of mesh-based techniques, he thought I was at first jesting, but then realized it was an interesting approach. In remembrance of Brian, we will illustrate a simple technique to convert a finite element discretization into a finite volume technique, allowing one to solve the altered method as a recursion relation.