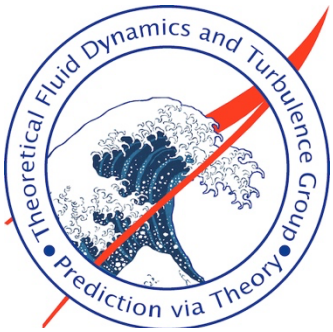
Alternative Analytical Solution for Planar Oblique Shock Waves



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One now famous analytical solution for shock waves was developed by Dr. Theodore Meyer within his Ph.D. dissertation under advisement of Professor Ludwig Prandtl. The original solution relies on analysis via control volume of the equations of motion. This approach has limited future development of analytical solutions for more complex flow-fields. In this presentation, we recover the classic solution of Meyer for the planar oblique shock wave via a new approach. We recast the Navier-Stokes equations in terms of generalized functions and an arbitrary surface that evolves in space and time. A closed-form solution for the density field is found, which depends on the integration of a Green's function and source. The source is a function of the ambient fluid properties and surface shape. The surface shape is constructed with the use of the product of multiple Heaviside functions. The integral is evaluated for the planar oblique shock wave. The newly derived approach yields exactly the same solution as presented by Meyer. The new method represents a possible avenue to attack unsolved canonical fluid flow problems.

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