Derivation of Ray Equations of a Polytropic Gas from Fermat's Principle

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Abstract

According to Fermat's principle, a ray going from one point P_0 to another point P_t in space chooses a path such that the time of transit is stationary. Given initial position of a wavefront Ω_0, we can use rays to construct the wavefront Ω_t at any time t. Huygens' method states that all points of a wavefront Ω_0 at $t = 0$ can be considered as point sources of spherical secondary wavelets and after time t the new position Ω_t of the wavefront is an envelope of these secondary wavelets. The equivalence of the two famous methods of construction of a wavefront Ω_t in a medium governed by a general hyperbolic system of equations does not seem to have been proved and **continues to remain open**, see
*http : //math.iisc.ernet.in/ prasad/prasad/preprints/*130908
_reprint_Huygens_Fermat_methods_General.pdf

I shall present a proof (by Russo and myself) only a part of the equivalence:

Fermat's principle $\Longrightarrow$ rays equations of Euler equations, governing the motion of a polytropic gas.