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Radial compressible fluid flow in $n > 1$ dimensions and their conserved integrals, invariants, symmetries and Casimirs

In this joint work with Stephen Anco conserved integrals and invariants (advected scalars) are studied for the equations of radial compressible fluid flow in $n > 1$ dimensions. Three invariants of up to first order had been found apart from the known entropy.

A recursion operator on invariants is presented, producing two hierarchies of higher-order invariants. One of them consist of Hamiltonian Casimirs. The other one holding non-Casimirs holds only for an entropic equation of state (EOS).

The Hamiltonian structure of the radial fluid flow equations in combination with these non-Casimir invariants provides a corresponding hierarchy of generalized symmetries. The Lie algebra of the first-order symmetries is non-abelian.

For the special cases of barotropic EOS and entropic EOS two new kinematic conserved integrals yield additional first-order generalized symmetries. These provide an explicit transformation group acting on solutions of the fluid equations.