On the nullcone of representations of reductive groups

Abstract:
Let $G$ be a complex reductive group and $V$ a $G$-module. Let $\pi: V \to V//G$ be the quotient morphism and set $N(V) := \pi^{-1}(\pi(0))$. Problem: When is the null cone $N(V)$ reduced, i.e., when is the ideal of $N(V)$ generated by $G$-invariant polynomials?
Jointly with G.W. Schwarz we have developed several methods to study this question, the method of covariants, a special slice method and a method based on the study of the weight system and the components of the nullcone. We have complete results when $G$ is $SL_2$, $SL_3$ or a simple group of adjoint type, and also when $G$ is semisimple of adjoint type and the $G$-module $V$ is irreducible.