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Principal Basis in Cartan Subalgebra

Let \mathfrak{g} be a simple complex Lie algebra and \mathfrak{h} a Cartan subalgebra. In this article we explain how to obtain the principal basis of \mathfrak{h} starting from a set of generators $\{p_1, \dots, p_r\}, r = \text{rank}(\mathfrak{g})$, of the invariants polynomials $S(\mathfrak{g}^*)\mathfrak{g}$. For each invariant polynomial p , we define a G -equivariant map Dp from \mathfrak{g} to \mathfrak{g} . We show that the Gram-Schmidt orthogonalization of the elements $\{Dp_1(\rho^\vee), \dots, Dp_r(\rho^\vee)\}$ gives the principal basis of \mathfrak{h} . Similarly the orthogonalization of the elements $\{Dp_1(\rho), \dots, Dp_r(\rho)\}$ produces the principal basis of the Cartan subalgebra of \mathfrak{g}^\vee , the Langlands dual of \mathfrak{g} .

Keywords: Lie algebra, Cartan subalgebra, principal basis, Langlands dual.

MSC: 17B