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ORTHOGONAL PROJECTIONS AND UNITARY REPRESENTATIONS OF LIE GROUPS

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This dissertation is primarily dealt with the study of orthogonality relations for Lie groups based on Haar integral and representation theory for Lie groups, which are considerable parts in Harmonic Analysis.

Sections 2 presents the general theory of Haar integral which is a radical background for the contents of section 3 and 4. We also derive the Haar measure μ on a Lie group G to get a Hilbert space $L^2(G, \mu)$ that will be used throughout the paper.

In section 3 we develop the elementary representation theory and prove some results on the unitary representations of Lie groups. It is particularly observed that if given a unitary representation $(\pi, (H, \langle , \rangle))$ of a Lie group G, we can construct a new unitary representation $(\tilde{\pi}, (\tilde{V}, (,)))$ by using a positive definite function $\varphi: G \longrightarrow C$. Section 3 also contains the descriptions of Peter-Weyl Theorem and various principal subjects on the representations that will be needed in section 4.

In section 4 we deal with the orthogonal projections of $(\tau, L^2(G))$ to $(\pi_r{}^* \hat{\otimes} \pi_r, V_r{}^* \otimes V_r)$ in connection with the Haar integral, and we prove some results concerning the orthogonality relations for compact Lie groups and the characters of finite dimensional irreducible unitary representations of compact Lie groups.

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