SUPPORT VECTOR MACHINE SKIN LESION CLASSIFICATION IN CLIFFORD ALGEBRA SUBSPACES

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Abstract. The present study develops the Clifford Algebra $C\ell_{5,0}$ within a dermatological task to diagnose skin melanoma based on images of skin lesions, which are modeled here by means of $5D$ lesion feature vectors (LFV). The LFV is a numerical approximation of the most used clinical rule for melanoma diagnosis-ABCD. To generate the $C\ell_{5,0}$ we develop a new formula that uses the entries of a $5D$ vector to calculate the entries of a $32D$ multivector. This vector provides a natural mapping of the original $5D$ vector onto the 2-, 3-, 4-vector $C\ell_{5,0}$ subspaces. We use a sample set of 112 $5D$ LFVs and apply the new formula to calculate 112 $32D$ multivectors in the $C\ell_{5,0}$. Next we map the 5D LFVs onto the 2-, 3-, 4-vector subspaces of the $C\ell_{5,0}$. In every subspace we apply a binary support vector machine to classify the mapped 112 LFVs. With the obtained results we calculate six metrics and evaluate the effectiveness of the diagnosis in every subspace. At the end of the paper we compare the classification results, obtained in every subspace, with results obtained by the four diagnosing rules most used in clinical practice and contemporary machine learning methods. This way we reveal the potential of using Clifford algebras in the analysis and classification of medical images.

Keywords: Clifford algebra, multivector, subspace, classification, skin lesion
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