INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: GEOMETRY COMPRESSION OF ISOMORPHIC AND BLOCK-ISOMORPHIC 3D ANIMATIONS

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SHORT ABSTRACT

The large volume of raw animation geometry data of complex 3D models demands for the efficient compression of these data with additional issues like spatio-temporal and quality scalability. Most of the 3D animation geometry compression methods use the animation data having equal number of vertices per frame with similar connectivity across all the animation frames. Such soft body dynamic mesh sequences are called *isomorphic* mesh sequences and the animation is characterized by the changes in geometry only. However, in real animations, the geometry as well as the connectivity of vertices in the 3D mesh sequence may change over time. Such types of mesh sequences are called *non-isomorphic* mesh sequences. In a particular case, the animation may comprise isomorphic objects in blocks of frames. The research work presented in this thesis focuses on the development of non-scalable and scalable methods for the compression of isomorphic and block-isomorphic animation geometry data. The major contributions of the thesis are as follows:

1) A compression algorithm is proposed for improving the existing clustering based PCA (CPCA). The proposed *subtractive clustering based clustered PCA* (S-CPCA) method provides a stable initialization of the cluster centres by applying the density function based subtractive clustering on the vertex trajectories.

2) A novel scalable compression method with an encoder and a decoder structure is proposed to obtain spatio-temporal scalability using the singular value decomposition (SVD) of the vertex trajectory matrix of the geometry data. The components of the spatial and temporal singular vectors are decomposed into different spatio-temporal layers to support scalability.

3) A novel technique for the compression of *block isomorphic multi-object* (BIMO) 3D animation geometry is proposed. The method applies a temporal segmentation algorithm to divide the animation data of the consecutive frames into different *isomorphic multi-object* (IMO) blocks. A spatial segmentation algorithm is applied on each IMO block to detect the individual 3D objects. An *object based PCA* (OPCA) algorithm is applied on the vertex trajectories of each 3D object to get better compression performance.

4) An improved perceptual visual distortion (PVD) metric called the *affine invariant spatio-temporal edge difference* (AISTED) metric is proposed for the quality assessment of 3D animations. The AISTED metric uses the relative changes in the spatial as well as the temporal edge lengths between the original and the reconstructed animations to measure the distortions in a perceptual manner, resulting in better correlation with the subjective scores than the existing *STED* and KG_{err} metrics.