Extracting Textural Features from Tactile Sensors

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Abstract

This paper describes an experiment to quantify texture using an artificial finger equipped with a microphone to detect frictional sound. Using a microphone to record tribological data is a biologically inspired approach that emulates the Pacinian corpuscle. Artificial surfaces were created to constrain the subsequent analysis to specific textures. Recordings of the artificial surfaces were made to create a library of frictional sounds for data analysis. These recordings were mapped to the frequency domain using Fast Fourier Transforms for direct comparison, manipulation and quantifiable analysis. Numerical features such as modal frequency and average value were calculated to analyze the data and compared with attributes generated from Principal Component Analysis (PCA). It was found that numerical features work well for highly constrained data but cannot classify multiple textural elements. PCA groups textures according to a natural similarity. Classification of the recordings using k nearest neighbours shows a high accuracy for PCA data. Clustering of the PCA data shows that similar discs are grouped together with few classification errors. In contrast, clustering of numerical features produces erroneous classification by splitting discs between clusters. The temperature of the finger is shown to have a direct relation to some of the features and subsequent data in PCA.