MXB201 Technical Report

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# Introduction

This report investigates two linear algebra-based approaches to modelling and interpreting high-dimensional image data. The report is divided into two sections corresponding to these tasks, outlining the methods used, results, and relevant visualisations.

Part I focuses on processing diffusion-weighted MRI scans: a common medical imaging technique used to examine soft tissue structures such as the brain. This is done to estimate the diffusion tensor at each voxel. By modelling signal attenuation as an exponential function of gradient direction and tensor components, an overdetermined linear system is formed and solved using least squares.From the estimated tensor, derived quantities such as mean diffusivity, fractional anisotropy, and principal diffusion direction are computed and visualised.

Part II examines a dataset of 1000 greyscale facial images. The reduced singular value decomposition is applied to extract eigenfaces, allowing dimensionality reduction and image reconstruction. These coordinates are used for basic feature classification, demonstrated through detecting the presence of a moustache. In the context of MRI scans, this process can be used for various functions, including the recognition of “biomarkers” to aid in identifying neurodegenerative diseases or tumours.