

Summer 2004 IPAM Research in Industrial Projects for Students

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Proposal: Image Fusion and Analysis

The research proposal consists of a number of problems in the general area of image analysis and fusion:

* Panoramic Image Stitching

Design and implement a robust algorithm for stitching several overlapping images together into a single panoramic image. This is a challenging problem which consists of a variety of components, including the automatic selection of feature points for matching between images, compensation for differences in exposure, transformation into the appropriate coordinates, and optimisation of the correspondence between feature points in each image.

* Combining Multiple Exposures for Dynamic Range Expansion

Digital cameras and film scanners have a limited dynamic range, which can be problematic when capturing images of high contrast scenes, or scanning high contrast slides. The available dynamic range may be significantly extended by capturing a number of images at different exposure settings (for example, in the simplest case, a long exposure to capture the shadow detail, but in which the highlights are blown out, and a short exposure to capture the highlights, but in which the shadow detail is lost) and digitally combining them. An effective solution to this problem will involve, inter alia, estimation of the transfer function of the relevant imaging device, and an understanding of standard intensity transforms, such as gamma correction.

* Image Inpainting and Restoration

This task is a continuation of the problem tackled by the 2003 LANL RIPS team, consisting of using the infrared channel on a film scanner to detect damaged areas of an image, which were then restored using inpainting. Since significant progress was made by the 2003 team, this task is less theoretical and more software development oriented.

The goal of the research project is a clearly written technical report

outlining the theoretical aspects of the work, together with an open-source software distribution implementing the algorithms, with appropriate documentation. While tools such as Matlab (or octave) are recommended for initial algorithm development, the final software distribution should be written in a standard language (preferably C or C++) for which open-source compilers are available on Unix platforms, and should build and run on a standard Linux installation.