Image-based three-dimensional data acquisition

Abstract

With the advance in image processing technology, many image-based three-dimensional data acquisition techniques have been developed and used in various applications including medical diagnosis, machine part inspection, movie and video game production, and many others. The objective of this tutorial is to give an overview of the basic principles of these techniques and discuss their latest development. The first part of this tutorial will introduce the basic principles of the fringe projection profilometry (FPP), which is one of the popular structured light illumination techniques for measuring the 3D shape of objects in a non-contact manner. Some latest development of robust FPP using the sparse representation techniques will also be discussed. The second part of this tutorial will cover the topic of motion capture (Mocap) data processing. The techniques for Mocap data compression will be introduced; and the applications of depth map camera will also be discussed.

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The first part of this tutorial is on the fringe projection profilometry (FPP) techniques for 3D measurement of objects' shape. It starts with an introduction of the background and applications of the FPP techniques. Some current applications of FPP in 3D microscopy, 3D endoscopes and other 3D medical devices will be explained. Then the principles of two majors FPP techniques will be elaborated. They include the Fourier transform profilometry (FTP) and phase shifted profilometry (PSP). Their limitations in practical working environment will also be illustrated. These limitations in general lower the robustness of the FPP in adverse working environments. Then two state-of-the-art sparse representation techniques for enhancing the robustness of FPP will be introduced. Simulation and experimental results will be shown to illustrate the effectiveness of these approaches. The second part of this tutorial is on motion capture data processing. It starts with an introduction of Mocap signal processing techniques. Some latest topics such as Mocap data recovery, low rank representation and trajectory-based representation of Mocap data will be discussed. In addition, the tutorial will also cover topics in Mocap sequence compression using the low rank matrix approximation and low latency Mocap data compression. At the end, two applications of Mocap data processing will be briefly discussed. Video demonstration will be shown to illustrate the performance of the applications.

Speaker

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