Tracking Articualted Figures with Cylindrical Limb Constraints

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The Problem: In order to facilitate gestural human-computer interaction in close quarters environments, we need to obtain information about person's pose and body and limb motion.

Motivation: An ability to obtain this information would be extremely useful in applications such as virtual reality, remote human identification (gait analysis), nonintrusive medical diagnostics, and others. The common way to model human body for this purpose is a kinematic tree which is parametrized on the sizes of the limbs and the joint angles. The tracking system will need to automatically initialize a model from the video, track persons for long periods of time (possibly tens of minutes), and be able to recover if it looses track.

Previous Work: There has been a lot of work done in person tracking over the last decade. A tracking framework based on the Condensation algorithm is presented in [1]. Vaillant and Faugeras describe a trinocular stereo based cylinder extraction method in [3].

Approach: In order to improve the matching speed and accuracy, we propose to first use motion and stereo to extract medium level 3D volumetric description of the scene from video (cylinders), and then use it for initialization and tracking.

Tracking may be initialized by grouping multiple cylinders with similar motion into limbs, and finding joint positions using methods from [2].

For tracking we propose to use the tracking framework of Sidenbladh et al. [1].However, to compute the likelihood of a distribution sample , we perform direct matching of the model to the generated volumetric description, instead of projecting the model into the image space and computing the normalized correlation.

Difficulty: The main problem with this approach, is that obtaining reliable volumetric descriptions of the scene is hard, but we expect that to be overcome by combining motion and trinocular stereo.

Future Work: Once a reliable person tracking system is available, it may be used for human identification and interaction within the Intelligent Room project.

Research Support: Project Oxygen, DARPA Human Identification at a Distance Program.

References:

[1] H. Sidenbladh, M. Black and D. Fleet. Stochastic Tracking of 3D Human Figures Using 2D Image Motion. Proc *ECCV 2000*.

[2] J. O'Brien, B. Bodenheimer, G. Brostow and J. Hodgins. Automatic Joint Parameter Estimation from Magnetic Motion Capture Data. .

[3] R. Vaillant, and O. Faugeras. Using Extermal Boundaries for 3-D Object Modeling. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 14, No. 2, Feb 1992.