CHAPTER 7 DISCUSSIONS AND CONCLUSIONS

7.1 Discussions and Conclusions

The focus of this dissertation is on development of marker-less system to estimate and track 3D articulated body (human body particularly in this dissertation) from an image sequence taken by an uncalibrated camera. The main concept of our approach is to reconstruct 3D relative human pose from 2D point correspondences. Our method consists of two main modules: 2D human body tracking and 3D articulated human reconstruction modules.

In the first module, an efficient part-based approach Quick Shift Belief Propagation (QSBP) for 2D human body tracking is proposed. It can reduce the computational time while preserving the accuracy. Instead of exponentially increasing number of human model candidates as the generative approach, our method converges with linear complexity of the number of subparts [29, 108, 101, 100, 102]. The generative approach considers all body parts at the same time, while part-based approach separately considers each body part and then combines into the global solution later.

Moreover, our approach works with local samples instead of evaluating all the possible states. From this concept, it needs a significantly smaller number of samples than other approaches in most of part-based approach [81, 28, 100, 101, 102, 103, 80, 43, 104] that leads to saving computational time. Additionally, the unique aspect of Quick Shift model is its ability to efficiently discover modes of the underlying marginal probability distribution. This gives our QSBP a significant advantage over approaches like Belief Propagation (BP) and Mean Shift Belief Propagation (MSBP) [29].

A motion model based on feedback information from the 3D human pose obtained and geometric constraint is introduced for initializing state and reinitializing state in case of lost tracking. Moreover, we apply such feedback information to alleviate several problems inherit from 2D human body tracking using a single camera, e.g. self-occlusion and observation ambiguity problems. In experiments, we present qualitative and quantitative analysis of the proposed approach with encouraging results.

For the second module, a novel approach to estimate and track of 3D articulated body from 2D point correspondences is proposed. Unlike previous approaches, our proposed method does not require camera parameters or a manual specification of the 3D pose at the first frame, nor does it require the assumption that at least one segment or one joint in every frame is parallel to the image plane. Our approach is based on perspective approach that gives more accurate that scale-orthographic approach [18, 19, 20, 9, 21, 22, 23, 24]. Multiple configurations are generally obtained from reconstruction of 3D articulate body due to a non-uniqueness problem. In this dissertation, an MHT-based tracking technique is introduced in order to select the best solution. Our proposed method outperformed other approaches, especially in scenes with strong perspective effects.

7.2 Suggestions

In case the human subject does not satisfy the Da Vinci's model, errors of segment lengths directly effect the joint position computation, especially at the end joints due to error accumulation. The severity depends upon the degree of the mismatch. The error can be alleviated by considering corresponding symmetric parts and introducing relaxation into the reconstruction.

For estimating and tracking 3D articulated human body in a movie footage, it is difficult to obtain our assumption in the first frame. To alleviate this problem, we can select a key frame that human appear as our assumption and then use that frame to determine reference distance and relative length of each segment for use in 3D reconstruction.

7.3 Publications

7.3.1 International Conference

1. Khongkraphan, K. and Kaewtrakulpong, P., 2007, "Robust Contour Tracking in Cluttered Background using Snake on Weighted- Gradient Image", **Proceedings International Workshop on Advanced Image Technology**, 8-9 January 2007, Bangkok, Thailand, pp. 638-642.

7.3.2 International Journal

1. Khongkraphan, K. and Kaewtrakulpong, P., 2010, "A Novel Method of 2D Articulated Body Tracking under Self-occlusion and Ambiguity", **IEICE Electronics Express (ELEX)**, Vol. 7 (2010), No. 15, pp.1106-1111.

2. Khongkraphan, K. and Kaewtrakulpong, P., 2011, "Efficient Human Body Tracking by Quick Shift Belief Propagation", **IEICE Transaction on Information & Systems**, Vol. E94-D, No. 4, pp. 905-912.

3. Khongkraphan, K. and Kaewtrakulpong, P., 2011, "A Novel Reconstruction and Tracking of 3D-articulated Human Body from 2D Point Correspondences of a Monocular Image Sequence", **Accepted by IEICE Transaction on Information & Systems**, Vol.E94-D, No.5.