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Automatic swimmer tracking using video sequences: Application to performance analysis

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In order to improve the performance of professional swimmers, we developed, in collaboration with the FFN (French Swimming Federation), an automatic tracking approach using video sequences. To do this, we proposed a new 8K shooting system adapted to the aquatic environment and allowing a pool calibration using the DLT technique (Direct Linear Transform). This establishes the link between pixel and metric coordinates, which allows, among others, to extract the concerned lane to carry out the different treatments. In order to initialize the tracking, it is necessary to localize the swimmer. For this, we applied a contrario technique to detect his movement in the lane. Then, the initial reference (swimmer's head) of our tracking system is detected using the proposed scaled composites JTC which is based on a pre-generated database. Afterwards, we implemented and adapted several tracking techniques, namely those based on the NL-JTC correlation, color histograms, Local Binary Patterns (LBP) and Histograms of Oriented Gradient (HOG). Given the various limitations of these techniques, we proposed an optimized approach based primarily on data fusion. This approach is called dynamic fusion and it combines NL-JTC correlation plane and color scores plane in order to generate a richer description of the target (form + color). This approach has shown very good results in the cases of visible target but it is still sensitive to occlusions. To solve this problem, we improved it by tracking simultaneously the head and the swimsuit of the athlete. This multi related targets approach enables, through a complex decision criterion, to find the occluded zone based on the visible one. Finally, a swimmer performance study is conducted and the results allowed validating the proposed system. In particular, we were interested in cyclical, intra-cyclical and instantaneous speed measurements, to study and improve the swimmers' performance.

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Layer dependency aware multi-view video delivery

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Multi-view video refers to a composite video stream generated by simultaneous capture from multiple cameras covering different portions or views of a scene. The Joint Video Team (JVT) has developed H.264/Multi-view Video Coding (MVC) to enhance the compression efficiency for multi-view video. Streaming of multi-view video demands high bandwidth even after encoding. Any loss during transmission will have effect on the real-time quality of experience (QoE) of the end user due to the prediction structure used in H.264/MVC encoder. We will address the challenges in delivering MVC video and introduce MVC delivery technologies in both the traditional client/server based model and peer-to-peer (P2P) based model. In the traditional client/server based streaming scenario, we have investigated the impacts of network fluctuations (e.g. packet losses) on the quality of streamed MVC video. The test results reveal unexpected differences in video quality among the streamed views. An MVC interleaving method is proposed to address this problem, which preferentially transmits the Network Abstraction Layer Unit (NALUs) with higher importance levels for decoding pictures. It reduces transmission errors on more important NALUs and hence enhances the streamed quality of different views. In the P2P delivery scenario, we have investigated the optimization problem of maximizing outbound bandwidth utilization of the peers in order to reduce bandwidth usage of the servers. The MVC layer dependency creates challenges in video layer sharing among the peers. The layers that can be shared between peers are limited by the layer dependency. A Bit-Torrent based layer-dependency-aware MVC video streaming system has been proposed and evaluatedT.

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