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Automatic quantification of displacement and ring generalship during high-level elite boxing competitions.

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INTRODUCTION:

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Ring generalship (RG), or ring occupancy, is an essential key performance indicator in elite boxing. Understanding position and movement of an opponent leads to defining better strategies, controlling the pace of the bout and imposing advantageous fighting ranges [1]. In addition to landed strikes, effective pressure and defense, RG influences the final score. Due to the high-intensity nature of boxing, fatigue is directly related to punch effectiveness as well as stances, even if the latter is significantly less studied in the literature. To date, little has been made available to measure and analyze the concept of RG in real-life scenarios, especially using automatic method to avoid any bias. The purpose of this study is to accurately track fighters locations inside the ring and extract relevant metrics.

METHODS:

Based on a single video camera, we automatically capture 2D position of each athlete onto the ring plane during a live combat. A tracking-by-detection algorithm [2] is first trained on a short sub-sample of the fight to detect unique boxers in the scene. The resulting classification allows to build a data-set specific to the bout (context, outfits, lighting). These specific features are used to retrain a multi-person detection algorithm [3]. By combining athlete detection and 2D keypoints estimation, we map features in an image coordinate system. Athletes positions with respect to the ring plane are derived from the feet joint locations and expressed in a metric world reference system through homographic transformation.

RESULTS:

32 fights (3 rounds \times 3 min) were studied with this method during a French elite national competition with the collaboration of the French Boxing Federation. During the event, 33 fighters (18 women, 15 men) competed, they traveled an average of $155 \text{ m} \pm 28$ per round. The average distance maintained between boxers was $1.23 \text{ m} \pm 0.16$. Our study addresses performance indicators such the distance covered by each athlete, heatmaps of the boxing activity, combat profiles (clinch phases, distances ...) and orientation of the fight in relation to the judges.

CONCLUSION:

In order to quantify RG during elite boxing combats, we proposed a suitable approach that required simple equipment for use in the wild. With only 96 rounds processed, more fights need to be collected to address the correlations between the metrics investigated in this study. During this event, all landed punches (15464 hits) were annotated by experts and will allow a more in-depth analysis in combination with our tracking data.

References

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