Institution: Kingston University

Unit of Assessment: 11, Computer Science and Informatics

Title of case study: Social and economic benefits from development of sports tracking technology

1. Summary of the impact (indicative maximum 100 words)

Research at Kingston University into methods for tracking sports participants in an arena have been translated into a BAFTA-award-winning system deployed by Channel 4 at the London Paralympics: a "multi-platform Optical Tracking solution for Wheelchair Rugby & Basketball, capable of detecting live impact speeds"

This system was deployed at the London O2 Arena and the Olympic Basketball arena, to provide real-time analysis of player speeds, cumulative distances, impact magnitudes, and other quantitative statistics. There are plans to extend and improve this technology for subsequent events.

This system had economic benefits for the commercial partner, DeltaTre Ltd, and social benefits in contributing to Channel 4's positive portrayal of disabled athletes.

2. Underpinning research (indicative maximum 500 words)

From 2001 to the present, the Digital Imaging Research Centre (DIRC) at Kingston University has been carrying out research into how computer vision methods can be used for tracking people in sporting events to obtain statistics about performance, tactics and fitness.

From 2002 to 2005, DIRC carried out research into new methods to extract useful information from the observation of sports activity through the processing of video signals. This was facilitated by agreements with Fulham and Queens Park Rangers Football clubs, and also by the 'INMOVE' FP7 project that investigated generation of content for mobile devices.

One objective of this research activity was the estimation of player position and velocity. After employing a suitable camera model to transform image to ground co-ordinates, there are still significant errors, and uncertainty, associated with these estimates. Issues such as occlusion, illumination and re-identification of individual team-mates remain challenges that must be met, to accomplish this objective. Thus, one aim for the research community is to propose methods and techniques that reduce the uncertainty associated with the estimated presence and positions of people in the scene. Researchers at Kingston have made several important contributions to this underpinning research. Orwell et al [1] showed how colour indexing could be used in a tracking context; Ellis and Xu [2] proposed a method to track people in the presence of partial observations. This was further developed by Ren, Orwell Jones and Xu [6], and then by Xu, Orwell and Jones [3] for tracking people in a sports context. In another paper, Ren, Xu, Orwell and Jones [5] developed a method for modelling the transformation of image plane uncertainty into ground plane uncertainty. Complete systems to obtain these estimates in a sports context were investigated and published [4].

The INMOVE project included user trials and evaluation, and a link between Kingston University and DeltaTre was established as part of the INMOVE project, as DeltaTre staff participated in user trials and expert interviews.

Key researchers: Graeme Jones (1993 – present, Professor), James Orwell (1998 – present, Reader) and Tim Ellis (2002 – present, Professor)

3. References to the research (indicative maximum of six references)

[1] James Orwell, Paolo Remagnino and Graeme Jones. "Multi-camera colour tracking." Visual Surveillance, 1999. Second IEEE Workshop on (VS'99). IEEE, 1999. [91 citations]

[2] Ming Xu and Tim Ellis. "Partial observation vs. blind tracking through occlusion." British Machine Vision Conference 2002 (BMVC'02), 2002. [69 citations]

[3] Ming Xu, James Orwell and Graeme Jones. "Tracking football players with multiple cameras." International Conference on Image Processing 2004 (ICIP'04), Vol. 5. IEEE, 2004. [60 citations]

[4] Ming Xu, James Orwell et al: "Architecture and algorithms for tracking football players with multiple cameras." Vision, Image and Signal Processing, IEE Proceedings, 152(2), 2005. [84 citations, Impact Factor 3.33]

[5] Jinchang Ren, Ming Xu, James Orwell, and Graeme Jones. "Multi-camera video surveillance for real-time analysis and reconstruction of soccer games." Machine Vision and Applications. 21(6): 855-863, 2010. [6 citations, Impact Factor 1.009]

[6] Jinchang Ren, James Orwell, Graeme Jones and Ming Xu, "Real-time modeling of 3-D soccer ball trajectories from multiple fixed cameras" in 'IEEE Transactions on Circuits and Systems for Video Technology', 18(3): 350-362, 2008. [15 citations, Impact Factor 1.819]

4. Details of the impact (indicative maximum 750 words)

In 2012, DeltaTre Media Ltd commissioned a system to be used in the London 2012 Paralympics, designed by Dr Orwell, to track the positions and speeds of the participants in the Paralympic Wheelchair Basketball and Wheelchair Rugby tournaments. This system exploited the research published in [3,4,5]: the same camera model was used, similar tracking algorithms, operating on partial observations, and described in [2], and the algorithms as described in [4] were used as to reidentify the participants after periods of occlusion.

This system was used as part of Channel 4's live coverage of 42 Paralympic matches, comprising two event types (Wheelchair Basketball and Wheelchair Rugby), and deployed in two arenas (the O2 arena and the Olympic Basketball Arena). In each match, the system was used to generate graphics that were made available to the television director, and to the Channel 4 website. The Channel 4 website area for these sports had approximately 140 hours of live coverage, over 500,000* hits, and comparable viewing figures for the televised matches. DeltaTre Media Ltd gained an economic benefit through the development of innovative broadcast technology which was delivered to Channel 4 and shown to a worldwide audience.

By providing statistics of speeds and impacts between players, this system was a component of the overall Paralympic coverage provided by Channel 4, which emphasised the strength and resilience of the competitors, challenging conventional stereotypes about disabled people.

The quality and significance of this coverage was recognised through the award of a BAFTA for this work, for Channel 4 and DeltaTre, in the Television Craft (Digital Creativity) category.

Channel 4's coverage of the Paralympics had a significant social impact: the public perception of disability and disabled people has changed as a result of this event and specifically of the media's portrayal of the athletes involved. The collaboration between Kingston University and DeltaTre made a distinct and material contribution to this impact, through the provision of innovative technology that enabled the broadcaster to present the sporting activities of disabled athletes in a new way.

5. Sources to corroborate the impact (indicative maximum of 10 references)

Major Survey by Charities Aid Foundation:https://www.cafonline.org/media-office/press-releases/2012/1009-paralympic-effect.aspx

Sunday Times article: http://www.thetimes.co.uk/tto/sport/athletics/article3803597.ece

English Federation of Disability Sport: http://www.efds.co.uk/news/1210_united_response_survey_finds_positive_impact_of_2012_paralympics

Poll for charity 'scope': http://www.scope.org.uk/news/paralympics-poll

Review by 'disability horizons': http://disabilityhorizons.com/2012/10/paralympics-games-2012-the-legacy-and-impact/

BAFTA award: http://www.deltatre.com/2013/04/deltatre-wins-digital-creativity-bafta-2/

Corroborating contacts:

1. Creative Director, DeltaTre Ltd: Use of people tracking system by DeltaTre for Channel 4 Paralympics coverage
2. Multiplatform Commissioning Editor for Sport, Channel 4: Use of people tracking system by Channel 4 for its Paralympics coverage