SESAME
SEnsing for Sport And Managed Exercise

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Project aims

• Primary aim is to develop practical techniques for monitoring the actions of sports men and women in order to provide them with information to enhance their training and performance.

• Initial application domain: sprinting

• The aims of the project are:
  – To model (part of) an athlete's body and its actions in biomechanical and physiological terms;
  – To support both athletes’ and coaches’ training and education
  – To compare and evaluate different athletes' actions and performance, identifying advantages and disadvantages.
  – To explore the feasibility of providing real-time feedback through non-invasive wireless signalling in order to correct actions and build ‘muscle memory’ (the proprioceptive sense).
  – To place the UK firmly at the forefront of sporting technology.
Vision

• Athletes are instrumented, using wireless sensor systems
  – Much current work done in the lab – using optical motion capture
  – That unobtrusively capture data about position, skeletal posture, muscular response and (later) physiology
  – Engineered not to cause injury, performance degradation, etc.
• Augmented with information from trackside monitors and auto-tracking video capture
• Information about performance is provided in a precise and appropriate way to coaches and to athletes
  – Using video and enhanced reality techniques
  – Using direct biofeedback
  – Combined with long term data storage and offline trend analysis
• Based on biomechanical models that are developed (partly) from captured sensor data
• Focus is on scientific rigour and practical deployment.
Consortium

- Existing links:
  - UWIC
  - RVC
  - CUCL
  - CUED

  - Locomotor biomechanics
  - Innovative sensor technology
  - Pattern recognition and signal processing

  - Location aware and sentient computing
  - Distributed sensor systems

  - Sports biomechanics
  - Performance measurement
  - Coaching

  - UCL CS

  - Embedded Systems
  - Wireless networking
  - MAC, QoS
  - Augmented reality

  - UCL CHIME
  - EHR
  - Decision support systems

SESAME presentation UKUbinet, July 12, 2006.
Existing work - RVC

An accelerometer and telemetry unit in place on the distal limb of a horse
Data – Signal Processing

Hard surface

1.9  a  b  Hoof
1.8  
1.7  
1.6  
1.5  
1.4  

MCP

A

Soft surface

1.9  a  b  Hoof
1.8  
1.7  
1.6  
1.5  
1.4  

MCP

E

Prox. phalanx

B

Prox. phalanx

C

Prox. phalanx

D

Prox. phalanx

F

Prox. phalanx

G

SESAME presentation UKUbinet, July 12, 2006.
Workpackage structure

• WP1: System architecture
  – Infrastructure for data filtering, fusion, etc. to produce application relevant events like start, stride, first 25 metres, etc.
  – Network services, QoS: timeliness, joint source/channel coding, MAC protocols, etc.
  – System autoconfiguration
    • Sensor abstraction framework – sensor event descriptors
    • Device discovery, specification of application level objectives, control protocols

• WP2: Signal processing & biomechanical modelling
  – Convert raw data into information
  – Don’t yet understand exactly what sensor data discriminates for effects of interest, so initially capture everything going
  – Develop biomechanical models – partly on basis of captured sensor data, but also acting as mechanisms for feedback to coaches, and to inform compression.
• WP3: Sensor system development
  – Create sensors to be attached to athletes
    • Localisation, body position and orientation, segment orientation, ground interactions, energy measurements, stance times, limb forces, ...
    – Sensitivity analysis on sensor placement and attachment using robotic arm
    – Gold standards based on optical measurement, robot arm
    – Semi auto sensor calibration methods

• WP4: Human factors and trials
  – Recruit and assess athletes
  – Evaluate and characterise elite sprinting
  – Provide input to biomechanical modelling from coaches
  – Assess effects of technology on performance
• WP5: Feedback and visualisation
  – Present information in a form that is meaningful to a human
    • Initially though overlay on video
    • 3D models from video input
    • Augmented reality and biofeedback

• WP6: Long term storage and analysis
  – Secure multimedia EHR database
    • Combining bulky video and sensor data with standards-based clinical records
    • High performance repository of multimedia data, augmented with suitable metadata
    • Query interface meaningful to coaches and athletes
    • Trend analysis
Deliverables

- Early deliverables:
  - Prototype wireless sensing systems
  - Automated video capture based on localisation
  - Robotic arm
  - Long term data storage
- Mid-term deliverables
  - Autoconfiguring wireless sensing systems
  - Signal processing and feature extraction
  - Biomechanical models
  - Visualisation
- Longer term deliverables
  - Performance evaluation
  - Coaching effectiveness
  - 3D visualisation
  - Biofeedback
  - Integrated EHR systems
Other partners

- Localisation
  - Ubisense
  - Forsberg Services

- Motion capture
  - PhaseSpace
  - Coda Motion
  - Vicon Peak

- Hardware
  - Sun
  - IMEC
  - XSens

- Sports science
  - Glaxo Smithkline (Lucozade Sports Science Academy)
  - Darren Campbell’s sprint academy
  - Technical advisory panel of elite coaches and athletes, including Darren Campbell, Welsh National coach, …
Conclusion

• Unique interdisciplinary research
• Ambitious, high-impact, very timely
• Internationally leading consortium
• Solid industrial engagement
• Wider applications
• Complementary to BiosensorNet