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Crowd physical motion and behaviour detection during evacuation from confined spaces

MENSUS Industry Showcase, 11/10/2016

Challenges for Big Data Analytics

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Big Data I

- Structured, semi-structured and non-structured data that is high in V^n → "Volume, Velocity, Variety, Veracity….."

- More than 85% of valuable information is unstructured and exists in the form of natural language texts in reports e-mails, messages, memos, notes from all sources which are generated during human activities and work operations. This is without the data and information generated by other parties using mainstream media and social networking channels and the internet

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Big Data? II

- Big data which is either Dark or ROT

- 52% of all information currently stored and processed by organizations around the world is considered '**Dark**' data, whose value is unknown. Additionally, another 33% of data is considered Redundant, Obsolete, or Trivial (**ROT**) and is known to be useless. If left as is, business data will unnecessarily cost organizations around the world a cumulative $3.3 trillion to manage by the year 2020.

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What is currently needed?

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- Hybrid Big Data IT infrastructure
  - Core applications designed to support decision-making organisations
  - Cloud services for on-demand and secure data access and analytics
- Need capabilities for ad-hoc connectivity and re-configurability of IT Infrastructure services

- These are mostly available as commercial commodities nowadays.

- From the Big Global Corporations such as IBM, Google, Amazon, Oracle, SAP etc..

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What is still currently needed?

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- ….a Strategic Data Processing Framework needs to be put in place on the Big Data Analytics for critical decision-support systems
  - Manage and control data under comprehensive policy and governance guidelines and ISO standards for monitoring systems
  - Capture and extract structured, semi-structured and unstructured data from trusted sources
  - Perform Analytics for delivery of the right contextual knowledge and advanced situation awareness to the right people at the right time for critical decision-support

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Strategic Big Data Processing Framework

- The framework which we developed at Southampton is generic and has been successfully applied to various domains.

- It inspires from the Multi-level JDL/DFIG approach on data fusion for decision-support and advanced situation awareness!

- Level 0 – Data Pre-processing
  - Quality
  - Provenance and Trust
  - Semantic gaps and conflicts reconciliations
  - Sensor Observation gaps removals
  - A-synchronicity, multi-modalities…

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Strategic Big Data Processing Framework

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- Level 1 – Data Post-processing: Aggregation
  - Compliance on condition monitoring and diagnosis standards (example: ISO 13374)
  - Harmonisation
  - Aggregation
  - Trust Metrics put in place
- Level 2 – Fast Data Mining and Exploration
  - Clustering
  - Background extractions
  - Foreground detections (Patterns)

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Strategic Big Data Processing Framework

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- Level 3 – Machine learning
  - Processes Operational Monitoring States Classifications
  - Correct Classification Rates (Targets >90%)
  - Confidence Levels Estimations
- Level 4 – Modelling Framework
  - Uncertainty Modelling and Propagation
  - Forecasting with Estimated Uncertainties
  - **Knowledge Modelling and Reasoning**

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• Big Data Analytics and Reasoning (I)

Athens International Airport (AIA) Satellite Terminal

[**Micro**]: information relevant to a person tracking, target direction, velocities
[**Meso**]: information relevant to an aggregation of features group energy, flows, densities
[**Macro**]: information relevant to a whole video feed kinetic energy, collectiveness

Reasoning entities (All available knowledge that advances our interpretation and decisions to make on observed crowd events):

[**Explicitly encoded**] *Spatial: gathering, egressing (needed to define expected target directions during normal operations and during evacuations), different types of transits etc…*
[**Implicitly encoded**] *Temporal: abstracted to define events (e.g. flight boarding time, order of evacuation)*

Zoheir Sabeur, Nikolaos Doulamis, Lee Middleton, Banafshe Arbab-Zavar, Gianluca Correndo and Aggelos Amditis. (2015). Multi-modal Computer Vision for the Detection of Multi-scale Crowd Physical Motions and Behavior in Confined Spaces. In Advances in Visual Computing. Volume 9474 of the series Lecture Notes in Computer Science, pp 162-173

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• Big Data Analytics and Reasoning (II)

eVACUATE project - http://www.evacuate.eu/ 2013-2017

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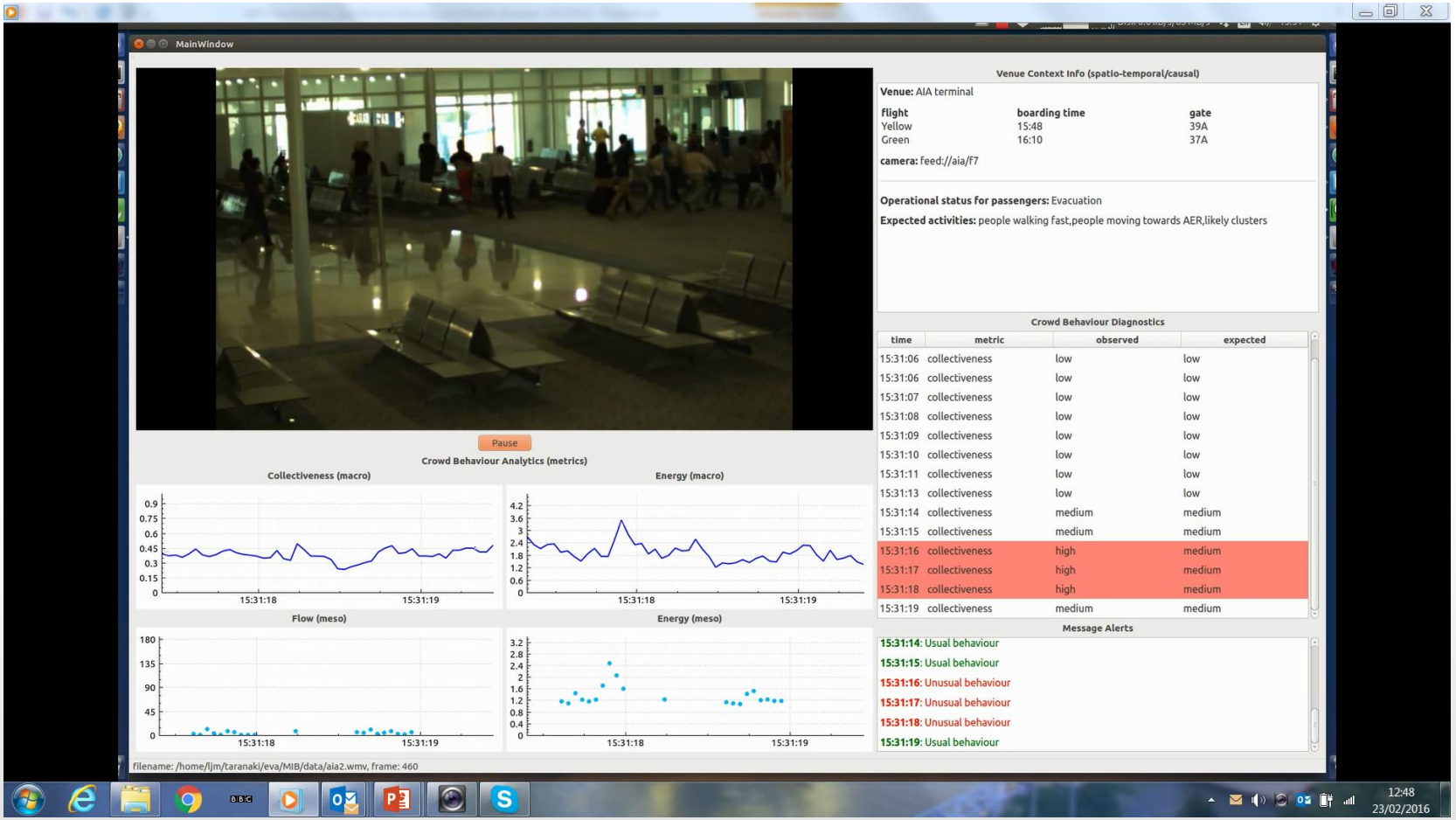
Athens International Airport Satellite Terminal



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• Big Data Analytics and Reasoning (III)

Real Sociedad Anoeta Stadium, San Sebastian, Spain

[**Micro**]: information relevant to a person tracking, target direction, velocities
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Reasoning entities (All available knowledge that advances our interpretation and decisions to make on observed crowd events):

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[**Implicitly encoded**] *Temporal: abstracted to define events (e.g. time, order of pre-match, match and post match schedules)*

Zoheir Sabeur, Nikolaos Doulamis, Lee Middleton, Banafshe Arbab-Zavar, Gianluca Correndo and Aggelos Amditis. (2015). Multi-modal Computer Vision for the Detection of Multi-scale Crowd Physical Motions and Behavior in Confined Spaces. In Advances in Visual Computing. Volume 9474 of the series Lecture Notes in Computer Science, pp 162-173

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- Big Data Analytics and Reasoning (IV)

eVACUATE project - http://www.evacuate.eu/ 2013-2017

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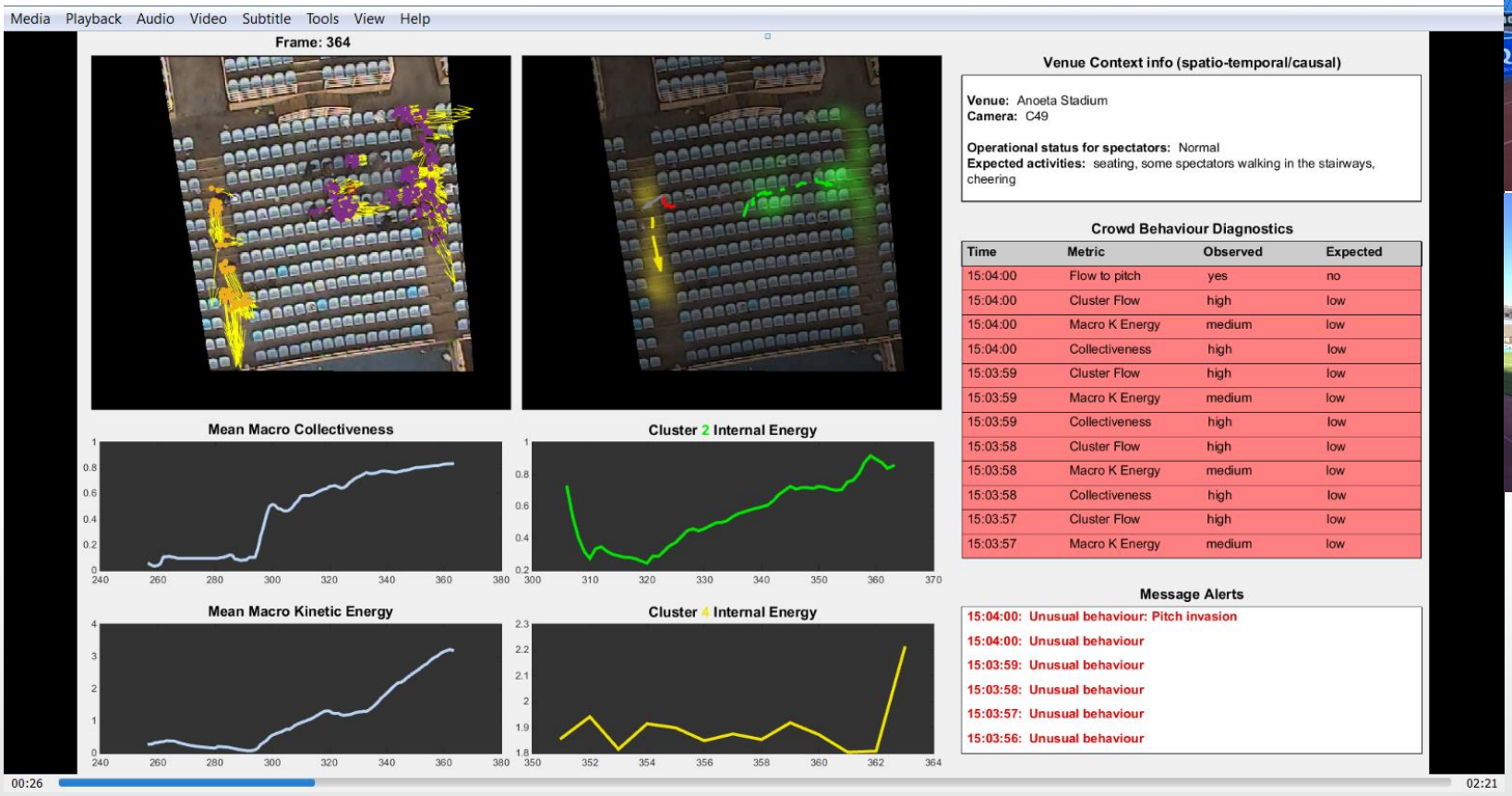
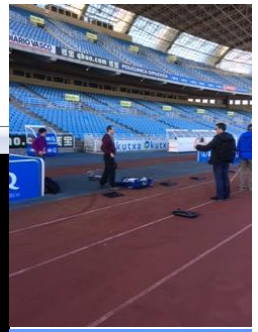
Anoeta Stadium, Real Sociedad FC, San Sebastian Spain.





IT Innovation research team experiment at Anoeta stadium

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- Big Data Analytics and Reasoning (V)

eVACUATE project - http://www.evacuate.eu/ 2013-2017

Anoeta Stadium, Real Sociedad FC, San Sebastian Spain.

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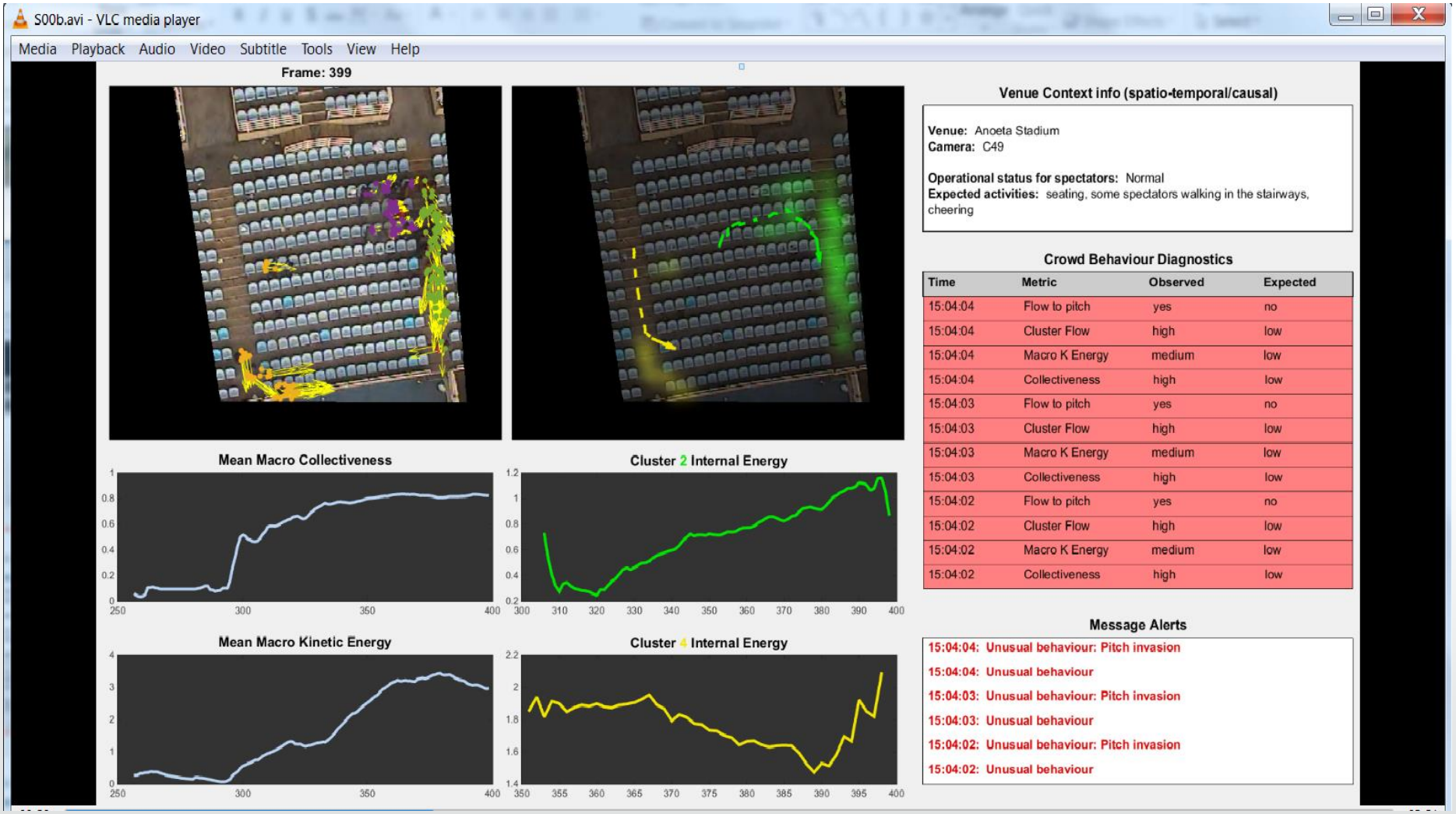

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UK SECURITY EXPO 2016 THE GLOBAL SECURITY SHOWCASE
DESIGN | SECURE | RESPOND
30 NOV – 1 DEC 2016, OLYMPIA LONDON

HM Government

PROTECTING CROWDED PLACES CONFERENCE
UK SECURITY EXPO

We will be presenting this approach on Crowd Analytics for Safety and Security at EXPO 2016 – See you there!

Thank You.

For more details, contact Dr Z. A. Sabeur:

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