

CASE STUDY

Challenges in Dynamic Imaging Data



Challenges

A number of challenges in the processing and analysis of time-varying data exist and are well documented.

Some of those specifically addressed at this workshop included:

- The parsing of a video sequence to provide a narrative of what is occurring remains a challenge, in terms of who or what is involved and their interactions.
- In medical imaging, rapid acquisition and processing of dynamic processes is challenging due to physical and technological limitations.
- The ability to rapidly process, interpret and extract meaningful conceptual information from large data streams, which is still beyond the current leading edge techniques.

BAE SYSTEMS

Background

Many challenges exist around the processing and analysis of time-varying data, such as how to manage time varying aspects in order to understand and analyse dynamic image content, detect objects, and track and analyse their behaviours so that what is happening in a sequence of images can be better understood.

Within this context and working in partnership with BAE Systems and with support from Microsoft Research, the TGM developed and ran a three day research workshop, in June 2015, attended by over 100 delegates. This sought to investigate this area with a focus on the analysis of very large and complex data streams (dynamic imaging data), where there is a need to improve techniques for the extraction of meta-information.

A key aim of the event was to understand what is currently possible and to explore the mathematical and technical challenges that need to be overcome to ensure progress in this field.

“We wanted to gain insights into possible solutions for technical challenges which exist around the area of analysis of very large complex data streams. This three day workshop presented an excellent platform for doing just this, as it brought together experts and stakeholders from a variety of areas, allowing us the opportunity to develop relationships and take forward collaborations of value to the Company.”

**Nick Easton, Head of Capability,
Applied Intelligence Labs,
BAE Systems Applied Intelligence**

Activity

The workshop brought together experts from a diverse set of backgrounds in mathematics, computer science and information engineering, including statistics, probabilistic modelling, machine learning, computer vision, information and data fusion, to discuss the state of the art in large-scale data perception, with a view to its applications across commerce and industry.

The programme of talks was designed to investigate the improvements needed in techniques, in order to gain a better understanding of the challenges that need to be overcome to ensure progress in the field.

Each of the three days featured an industry focus, with Siemens presenting medical imaging challenges, BAE Systems highlighting security issues and Microsoft Research raising the challenges for media and creative industries. The programme also provided the opportunity for a number of early stage researchers to present posters and to share short presentations on their work and gain insight from the industry delegates.

Impacts

A number of promising approaches and techniques were identified and one theme that was explored related to the value of deep learning, automatic learning systems and the application of deep learning in machine learning.

Other techniques and areas that were highlighted as having real value in addressing some of the challenges were:

- A desire for higher levels of abstraction of algorithm design from coding, to allow the implementation of algorithms onto a greater number of platforms by those not an expert in the platform.
- The role of machine learning.
- The impact of emerging capabilities on privacy and its protection.
- Approaches where the technology being produced can work in a wide range of fields on a common problem.

Some important future research directions were identified, including:

- In deep learning, where there is substantial interest in developing deep learning convolution neural network applications in order to simplify some of the computations associated with object identification.
- The potential for the human vision and machine vision communities to work closer together in the future, to help address some of the technical challenges, such as in cognitive understanding.
- Although some of the right communities are joined up, there does appear to be a disconnect in that the right mathematicians (maths analysis, statisticians) are not involved properly. There is a need for more synergy with industry and academia, as well as a desire to be more ambiguous at addressing issues of a longer term nature.

A benefit to BAE Systems was the exposure to the academic research community, particularly around being able to articulate challenges in the dynamic images area to an audience of relevant experts. This provided them the opportunity to define bespoke BAE Systems maths problems and some direct outcomes of the workshop were the establishment of projects with 2-3 universities.

A number of other collaborative opportunities have been explored between delegates and the outputs from the workshop will feed into the Isaac Newton Institute Research Programme on "Variational Methods and Effective Algorithms for Imaging and Vision" which takes place in 2017.

