

Computer Vision and Modelling in Cancer: BMVA 1 day meeting

Chairs: Constantino Carlos Reyes-Aldasoro and Greg Slabaugh (City, University of London)

#bmvacancer



Figure 1. The chairs of the meeting, Greg and Carlos.

The one-day meeting was dedicated to present technological advances in Cancer Research from two areas: Computer Vision and Mathematical Modelling, to bring together researchers to discuss theoretical and practical viewpoints to spur further advances in the field.

The event kicked off with a brief introduction from the chairs, Drs Constantino Carlos Reyes-Aldasoro and Greg Slabaugh - Senior Lecturers at City, University of London. Carlos shared some insights about the rise of cancer research compared to other topics and the impact of Computational and Mathematical approaches to Cancer, which motivated this meeting.

The first speaker, **Jola Mirecka** from the University of Oxford, talked about tumour subregional analysis, and the impact of local variation and local similarities. Following on this presentation, the first Keynote was given by Dr **Yinyin Yuan** -Institute of Cancer Research- where histology deep learning is being used to decipher the Tumour Ecosystem. Through the research she presented, tumours have been found to be heterogeneous with different types of cancer cells, vessels, etc. Approaching tumours this way should have an impact on how we understand the lifespan of the tumour.

Antonia Creswell presented her doctoral work at Imperial College London in classifying skin lesions through a combination of labelled (Conditional Denoising Adversarial Autoencoder) and unlabelled data.

The second keynote speaker was Dr **Ben Glocker** from Imperial College London, who presented an interesting talk on brain tumour segmentation with deep neural networks. Ben discussed the *agony of choice* the field has encountered thanks to the widespread use of deep learning technologies and tried to propose a resolution to it through combinations of various approaches. Finally, some challenges for the future of the field presented include: (i) learning the right features, (ii) detecting when the model goes wrong, and (iii) exceeding human-level performance.

A collection of 19 posters (listed below) were presented in conjunction with lunch. Posters spanned a variety of data analysis methodologies and clinical applications in cancer.

The second half of the meet kicked off with a keynote from Prof **Nasir Rajpoot**, reviewing the work being done in the Computational Pathology Research Group at Warwick University. The talk reviewed computer vision algorithms used in pathology image analysis, spanning the areas of pre-processing, analysis, synthesis, biomarker detection and AI analytics.



Figure 2. The oral presentations and poster session covered a wide variety of topics in cancer image analysis and modelling and provided an excellent opportunities for scientific exchange and detailed discussions.

Regarding the mathematical modelling aspect of the workshop, **Tim Ingham-Dempster** from the University of Sheffield, introduced an agent based model of the human colon at a cellular level, and the latest work he has been doing on extending what was learned from the original model into a newer model of the *crypts* in the colon to model the spread of cancer in the human colon. Continuing with the topic of colorectal cancer, **Zhaoyang Xu** from Queen Mary University of London provided a talk on multi-scale semantic segmentation of colorectal cancer liver metastasis (CLRM). The main objective is to aid diagnosis and help with the treatment plan.

The final keynote was given by Prof **Helen Byrne** from the University of Oxford. Her talk focused on study cases where a sound mathematical model was useful in interpreting cancer related applications. Prof Byrne explained how the algorithms they developed could benefit from validation and interpretation of real use cases. Two cases she presented involved the aids in the design of an experimental protocol for estimating interaction terms of equations; as well as a use case in which synthetic models helped in reduce complexity, producing the same qualitative behaviour.

As a follow-on to the meeting, the organisers have arranged for a Special Issue of the

journal IET Computer Vision dedicated to Computer Vision in Cancer Data Analysis. Submission deadline: 31 Dec, 2017.

Nathan Olliverre,
José Alonso Solís-Lemus,
City, University of London

Poster session

1. Guang Yang, Imperial College London
MRI Brain Tumor Segmentation using Random Forests and Fully Convolutional Networks
2. Zobia Akram, Aberystwyth University
Mammographic Mass Classification Using Filter Response Patches
3. Said Pertuz, Tampere University of Technology
Algorithms and Methods for Computerized Analysis of Mammography Images for Breast Cancer Risk Assessment
4. Zheqi Yu, University of Wolverhampton
A Real-time Assistive Diagnosis System for Esophageal Adenocarcinoma and Colorectal Cancer
5. Bartłomiej Papiez, University of Oxford
Towards Automated Non-invasive Monitoring of Metastatic Tumour Growth for Preclinical Studies
6. Adam Szmul, University of Oxford
A Novel Approach for Deformable Lung Image Registration Using Over-Segmentation based

on Supervoxels, Graph Cuts and Guided Image Filtering

7. Joseph Jacobs, University College London

Semi-supervised Prostate Nucleus Classification with Convolutional Neural Networks

8. José Alonso Solís-Lemus, City, University of London

Segmentation of Overlapping Macrophages Using Anglegram Analysis

9. Alison Pouplin, Imperial College London

Modelling the Evolution of Skin Lesions Over Time Using a

Bidirectional Generative Adversarial Network

10. Nashid Alam, Aberystwyth University

Computer-aided Classification of Microcalcification Cluster in Digitized Mammogram for Early Diagnosis of Breast Cancer

11. Nathan Olliverre, City, University of London

Pairwise Mixture Model for Unmixing Partial Volume Effect in Multi-voxel MR Spectroscopy of Brain Tumour Patients

12. Paul Tar, University of Manchester

Mathematical Modelling of Tumour Heterogeneity Increases Statistical Power in Assessing Response to Therapy

13. Arti Taneja, Amity Institute of Information Technology

Breast Cancer Grading Visualisation Based on Earth Mover's Distance

14. Muhammad Shaban, University of Warwick

Representation-Aggregation Networks for Segmentation of Multi-Gigapixel Histology Images

15. Tzu-Hsi Song, University of Warwick

Simultaneous Cell Detection and Classification with an Asymmetric Deep Autoencoder in Bone Marrow Histology Images

16. Simon Graham, University of Warwick

Classification of Lung Cancer Histology Images using Patch-Level Summary Statistics

17. Talha Qaiser, University of Warwick

Tumor Segmentation in Whole Slide Images using Persistent Homology and Deep Convolutional Features

18. Najah Alsubaie, University of Warwick

Survival Analysis of Lung Cancer Patients using Nuclear Features

19. Navid Alemi, University of Warwick

Deep Learning for Lung Cancer Histology Image Analysis