



ERCIM "ALAIN  
BENSOUSSAN" FELLOWSHIP  
PROGRAMME



## Scientific Report

First name / Family name

Basheer Alwaely

Nationality

Iraqi

Name of the *Host Organisation*

NTNU

First Name / family name  
of the *Scientific Coordinator*

Ali Alsam

Period of the fellowship

01/12/2019 to 30/11/2021

### I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

- 1- Partially co-taught the Digitalization Course (ITO1000 V21) in Computer Science (IDI). In particular, I taught the part related to Artificial intelligence (AI).
- 2- Participating in the exam grading at NTNU.
- 3- Exploring the image colour fidelity by examining different image channels.
- 4- Applying the state-of-the-art techniques for human action recognition that includes object detection, tracking and localization.
- 5- Conducting research on using AI for image colourizing. This includes benchmarking different state-of-the-art techniques on a variety of datasets.
- 6- Exploring the use of computer vision and machine learning for image manipulation detection.
- 7- Learn Norwegian. I attended a Level 1 Norwegian language course.
- 8- I was part of Dr. Ali's group where I improve my research management and collaboration.
- 9- Regular meeting with the scientific coordinator to discuss and update work progress.

## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

- 1- Basheer Alwaely and Charith Abhayaratne." AGSF: Adaptive Graph Formulation and Hand-Crafted Graph Spectral Features for Shape Representation" IEEE Access. 2020 September 30; Volume 8,10.1109/ACCESS.2020.3028696. (Accepted)

"Addressing intra-class variation in high similarity shapes is a challenging task in shape representation due to highly common local and global shape characteristics. Therefore, this paper proposes a new set of hand-crafted features for shape recognition by exploiting spectral features of the underlying graph adaptive connectivity formed by the shape characteristics. To achieve this, the paper proposes a new method for formulating an adaptively connected graph on the nodes of the shape outline. The adaptively connected graph is analysed in terms of its spectral bases followed by extracting hand-crafted adaptive graph spectral features (AGSF) to represent both global and local characteristics of the shape. Experimental evaluation using five 2D shape datasets and four challenging 3D shape datasets shows improvements with respect to the existing hand-crafted feature methods up to 9.14% for 2D shapes and up to 14.02% for 3D shapes. Also, for 2D datasets, the proposed AGSF has outperformed the deep learning methods by 17.3%"

- 2- Basheer Alwaely and Ali Alsam." Exploring the effect of blue resolution and sparsity on image colour fidelity", Submitted towards Journal of Imaging Science and Technology, 2021. (Pending)

"The human vision is the most important sense organ, and it is crucial to understand how it works. In the human eye, cones can be divided into "red" cones (64%), "green" cones (32%), and "blue" cones (2%). This raises an important question; how can we see colours even with almost no blue information? Therefore, in this paper, we address this issue by using convolution neural networks to mimic human vision. We distort the blue information of the image, and our model efficiently recovers the full colour detail. The proposed model evaluates on different datasets, Gaussian kernel sizes and measurement matrices. The performance evaluation demonstrates that our model enabled an efficient reconstruction with 96% structural similarity and 35.32 peak signal to noise ratio."

### III – ATTENDED SEMINARS, WORKSHOPS, CONFERENCES

- 1- Basheer Alwaely, “Adaptive Graph Fourier Transform for Image Compression”, Seminar at the computer science department, NTNU, 11/03/2020.
- 2- Basheer Alwaely, “First year progress report”, NTNU, 24/09/2020.
- 3- Basheer Alwaely, seminar on Machine Learning at RISE given by Debabrota Basu from INRIA on "Quantifying composite Uncertainty and its application in risk-sensitive reinforcement learning", online, June 10, 2021.

### IV – RESEARCH EXCHANGE PROGRAMME (REP)

The Research Exchange Program (REP) was jointly conducted between me (Basheer) as an ERCIM follower at NTNU and Olof Mogren, John Martinsson, Edvin Listo and Erik Ylipää at RISE. We started our first online meeting on June 2, 2021 and ended on June 10, 2021. During this period, we met online three times and achieved the following tasks:

- 1- Olof provided a clear introduction about teamwork at RISE, this includes the-state-of-art techniques on adversarial representation learning for private speech generation, adversarial representation learning for synthetic replacement of private attributes, sound-based fire detection.
- 2- I provided an introduction about my current and previous works, and this includes graph spectral domain for shape matching, object detection/tracking/counting, and the recent trends of deep fake detection.
- 3- We discuss topics of common interest, especially work related to the Generative Adversarial Network (GAN).
- 4- We also agreed to expand the discussion into a possible collaboration with Shahid and Joakim at RISE in detecting fake images.
- 5- I also attended a seminar on Machine Learning at RISE given by Debabrota Basu from INRIA on "Quantifying composite Uncertainty and its application in risk-sensitive reinforcement learning".

**I would like to take this opportunity to express my gratitude to my scientific coordinator Dr. Ali Alsam who provided insight and expertise that greatly assisted the research. I am especially indebted to him for sharing his pearls of wisdom and experience during my fellowship.**

**I would also like to thank Emma, Catherine, and Olof for all the support and assistance during the fellowship period.**

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