



ERCIM "ALAIN BENSOUSSAN"
FELLOWSHIP PROGRAMME



Scientific Report

First name / Family name	Ahmed ELARABY
Nationality	Egyptian
Name of the <i>Host Organisation</i>	NTNU
First Name / family name of the <i>Scientific Coordinator</i>	Faouzi Alaya CHEIKH
Period of the fellowship	01/06/2018 to 31/05/2019

I. SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

During my fellowship at NTNU, My research work focused on developing image processing algorithms for medical sector. Medical imaging has developed into one of the most important fields within scientific imaging due to the rapid and continuing progress in computerized medical image visualization, advances in analysis approaches and computer-aided diagnosis. By the growing use of direct digital imaging systems for medical diagnostics, digital image processing becomes more and more important in healthcare field. In addition to originally digital techniques, such as Magnetic Resonance Imaging (MRI) and Computed Tomography (CT), initially analogue imaging modalities such as radiography or endoscopy are nowadays equipped with digital sensors. Based on medical imaging techniques, the entire spectrum of image processing is now applicable in medicine. Multiplicities of diagnostic medical imaging modalities are used to probe the body of human. Resulting images interpretation requires sophisticated image processing approaches and techniques that enhance visual interpretation, and image analysis approaches that provide automated or semi-automated tissue detection, characterization and measurement. In this context, my proposed research focused on two main associated issues: image enhancement/ quality assessment and segmentation. The research on these three aspects has been successful and has contributed to strengthen and broaden my areas of expertise and interest.

Another key objective of the fellowship was to expand my scientific network. Several activities have been conducted to achieve it. First, I have experienced rich interactions and collaborations with researchers of the host organization and of other

international organizations. Second, I have attended several research events, including conferences and workshops. As the result of the networking, I have been invited to participate in both national and European project proposals. I have participated in the preparation and submission of project proposals and have applied for two calls for postdoc grants. I have participated in some research activities in Europe research project “HiPerNav” related to my areas of expertise.

With the goal of developing my research, communication and teamwork skills, I have attended “HiPerNav” workshop, given by Paris 13 University, and “HiPerNav” workshop given by INRIA, Strasbourg, France.

Summarizing, the ERCIM fellowship has substantially contributed to develop my scientific career, to increase the impact of my research, to expand my network, to shape my research vision and to clarify my priorities and objectives. Finally, I would like to remark that NTNU, and in particular the group led by my Scientific Coordinator, has provided me a perfect environment to interact with other researchers and to develop my scientific career. That is the reason why I really hope to keep the collaboration with them in the future.

II. PUBLICATION(S) DURING YOUR FELLOWSHIP

- A. Elaraby, Faouzi Cheikh, “*A Framework for Medical Images Segmentation Based on Fuzzy Exponential Entropy and Differential Evolution.*” ICMIS 2019.
- A. Elaraby, Faouzi Cheikh, “*An Approach for Image Quality Assessment Using Intuitionistic Fuzzy Sets*” ICNHBAS 2019 “Accepted”.
- A. Frouk, A. Elaraby, Faouzi Cheikh, et al., “*Quantum Medical Images Processing: Foundations and Applications*” submitted
- A. Elaraby, Faouzi Cheikh, “*Deep Learning on Image Enhancement: An Overview*” to be submit.
- A. Elaraby, Faouzi Cheikh, “*Cross-Modality Guided Contrast Enhancement of Liver*”. Under preparation.

III. ATTENDED SEMINARS, WORKHOPS, CONFERENCES

- I attended several seminars organized by Norwegian Colour and Visual Computing Laboratory (Colourlab) group at Department of Computer Science, NTNU Gjøvik.
- **One-day seminar** - “*Welcome to Norway*” 18th of June 2018, Gjøvikregionen Utvikling, Jernbanetorget 3, 2821 Gjøvik. During this seminar, the following topics discussed:
 - *Introduction to Norway, Gjøvik and surrounding areas Country, history, economy, government.*
 - *Immigration / Settling in, health and social security.*
 - *Culture, work culture, challenges, pit falls.*
 - *Practical information.*

- I attended the following workshop:
 - Event:** *HiPerNav Workshop on Image Quality Assessment.*
 - Venue:** *Paris 13 University, Paris, France.*
 - Duration:** *6-7 December 2018.*
- I attended the following workshop:
 - Event:** *HiPerNav training event in Strasbourg.*
 - Venue:** *INRIA, Strasbourg, France.*
 - Duration:** *10-12 December 2018.*
- I attended some activities “Forskingsdagene” Science week NTNU Gjøvik:
 - **Event:** *Forskingsdagene” Science week in NTNU Gjøvik.*
 - **Venue:** *Universitetsbiblioteket i G-bygget.*
 - **Duration:** *18-30 September 2018.*
- I attended “Colour and Visual Computing Symposium 2018 (CVCS 2018)” NTNU Gjøvik:
 - **Event:** *Colour and Visual Computing Symposium 2018 (CVCS 2018)”.*
 - **Venue:** *A232 Colourlab, Department of computer science, NTNU.*
 - **Duration:** *9:00-20:00, 18 -20 September 2018.*

IV. RESEARCH EXCHANGE PROGRAMME (REP)

In my research exchange programme, I visited the following lab:

Location: INRIA, Strasbourg, France.

Scientific Coordinator: Prof. Stéphane Cotin

Duration: December 6-12, 2018.

Experience: During my visit to INRIA, we discussed about potential collaborations in the area of advanced image processing. I had the opportunity of fruitful interactions, discussions and exchange ideas with the researchers of the group and Prof. Stéphane Cotin that helped me a lot towards the development of my research and for potential research collaborations. I also gathered information on relevant projects that INRIA team are working on and expanded my knowledge on research and development activities from academic perspective. Also, during my visit to France, I participated on H2020 MSCA HiPerNav project workshop held in Paris on Dec 6-7, 2018 and in Strasbourg on Dec 10- 12, 2018.