



Fellow	Dr. Jobin Francis
Host Organisation	Norwegian University of Science and Technology (NTNU)
Scientific coordinator	Prof. Sony George



I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

During the ERCIM fellowship, the scientific activities focused on designing and developing effective solutions for examining the food quality attributes using hyperspectral imaging (HSI) techniques. I conducted thorough literature reviews, designed and executed experiments, analysed the data, and interpreted the findings. This led to address and achieve the key research objectives such as the non-invasive measurement and evaluation of Soluble Solids Content (SSC) in kiwifruit, the non-invasive prediction of spatial variation of SSC in watermelons, etc. The methods developed in this project can be extended to wide range of food items and results will be highly relevant for the sector.

I started at NTNU in May 2023 and worked on research involving the quantitative evaluation of a range of foods, fruits, and vegetables using HSI systems. As a researcher under this fellowship, I have received training on using various hyperspectral cameras, spectral data acquisition, and designing various lab environments. In addition, I have well-employed regression, classification, and clustering techniques to formulate and build a variety of optimization methods and chemometric models

Throughout the fellowship, I collaborated with colleagues both within and outside of my research group - Colourlab, exchanging ideas and expertise to advance our collective understanding in the research field. These collaborations resulted in several research articles as listed in Section II.

Furthermore, I have actively participated in scientific conferences, workshops, and seminars to disseminate the research findings, receive feedback from peers, and engage in discussions with experts in the field. These interactions not only enriched my knowledge but also contributed to the broader scientific community.

Overall, my fellowship provided a valuable opportunity to contribute to cutting-edge research, enhance my skills as a researcher, and make meaningful contributions to the scientific community.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

During my fellowship, I have contributed to several publications that have significantly advanced in the vast domain of quality analysis of food attributes by employing



hyperspectral imaging. The list of my publications is presented below in the order of title, journal name, authors, year, and status:

1. Francis, Jobin, George, Sony, Devassy Binu Melit, George, Sudhish N., 'Quantitative Assessment of Hayward Kiwi Soluble Solids Content Prediction Using Hyperspectral Imaging', 13th Workshop on Hyperspectral Imaging and Signal Processing: Evolution in Remote Sensing (WHISPERS), Oct-31-2023 to 02-Nov-2023, (Presented). doi: <https://doi.org/10.1109/WHISPERS61460.2023.10430498>
2. Francis, Jobin, George, Sony, Devassy Binu Melit, George, Sudhish N., 'Development of a Unified Framework of Low-rank Approximation and Deep Neural Networks for Predicting the Spatial Variability of SSC in `Spania' Watermelons using Vis/NIR Hyperspectral Imaging; Postharvest Biology and Technology, Elsevier. (**Under Review**)
3. Francis, Jobin, George, Sony, Devassy Binu Melit, George, Sudhish N., A Quantitative Analysis and Mapping of Soluble Solids Content with Interior Regions of `Hayward' Kiwifruit from Centre to Pericarp using Hyperspectral Imaging and Chemometric Algorithms', Microchemical Journal, Elsevier (**Required Reviews completed and waiting for the decision from the editor**).
4. Francis, Jobin, George, Sony, George, Sudhish N, 'Recent Advances in Non-destructive Measurement of Internal Fruit Quality Attributes using Hyperspectral Imaging Systems and Machine Learning Techniques: A Review', Applied Spectroscopy, Taylor & Francis (**With the editor**).
5. Francis, Jobin, George, Sony, George, Sudhish N, 'Development of a deep learning based regression framework for predicting the spatial variability of SSC in the interior part of sliced watermelons using Vis/NIR Hyperspectral Imaging'. (Under preparation)

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

1. 13th Workshop on Hyperspectral Imaging and Signal Processing: Evolution in Remote Sensing (IEEE-WHISPERS), 31-Oct to 02-Nov 2023, Athens- Greece.
2. Strategic seminar organized by Colourlab, IDI, NTNU Gjovik at Hoel Gard, on 15-16 June 2023.
3. Weekly seminars "Colourlunch" at the research group Colourlab, NTNU.



IV – RESEARCH EXCHANGE PROGRAMME (REP)

I have visited Fraunhofer Institute for Computer Graphics Research IGD, Germany, as part of the research exchange program (REP) during 15-24 January, 2024. The main motivation to choose this group for the REP was its vast experience and reputation in the field of visual computing, computer graphics and computer vision to develop innovative technological solutions.

Throughout the visit, I had the opportunity to engage in various scientific activities, including engaging scientific discussions and project meetings, where I actively exchanged ideas with experts in computer vision and machine learning. I am grateful for the opportunity to contribute to enriching scientific discussions during my visit.

I am excited about the potential for future collaborations between Fraunhofer IGD and NTNU, and look forward to continued success in my academic pursuits.