



TC ANNUAL REPORTING FORM

IMS Technical Committee

TC-19 Imaging Signals and Systems

Reporting period 2020-2021

Starting date (dd/mm/yy)	Ending date (dd/mm/yy)	Date of submission (dd/mm/yy)
2020-2021		

Website	Last update (mm/yy)

TC Chair or co-Chairs

Chair: George C. Giakos, Manhattan College, USA

Co-Chairs: Michalis Zervakis, Technical University of Crete, Greece

Jacob Scharcanski, Federal University of Rio Grande do Sul (UFRGS), Brazil

Secretary (check the right box) Present Not Present

First Name	Second Name	Family Name	Affiliation /Address	Membership number	Phone	e-mail address	Date of election

TC Membership list^(*)

Matteo Pastorino, University of Genoa, Italy

Lijun Xu, Beihang University, China

Lihui Peng, Tsinghua University, China

Sos Agaian, The Graduate Center, CUNY, NY, USA

Chi-Hung Hwang, National Applied Research Laboratories, Taiwan

Yixin Ma, Shanghai Jiao Tong University, China

^{*} Please add as many rows as needed

Wuqiang Yang, University of Manchester, UK
Vicenzo Piuri, University of Milan, Italy
Suman Shrestha, ONN Semiconductors, USA
Aditi Deshpande, University of Arizona, USA
Michalis Zervakis, Technical University of Crete, Greece
Keerthi Valluru, Stanford University, USA
Andrzej Skalski, AGH University of Science and Technology, Poland
Cesare Svelto, Polytechnic of Milan, Italy
Mel Siegel, Carnegie Mellon, USA
Luay Fraiwan, Abu Dhabi University, HE
Mohd. Zaid Abdullah, Universiti Sains Malaysia, Malaysia
Richard Picard, ARCON Corporation, USA
Emil Petriu, University of Ottawa, Canada
Nicolas Douard, Manhattan College, USA
Edmund Lam, University of Hong Kong, China
George Livanos, Technical University of Crete, Greece
Antonios Gasteratos, DUTH, Greece
Jiamin Ye, IET, China
Kanchan Lata Kashyap, Indian Institute of Information Technology, Design and Manufacturing (IIITDM), India
Chi-Hung Hwang, National Applied Research Laboratories, Taiwan
Kostas Marias, Foundation for Research and Technology, Greece
Tannaz Farrahi, University of Virginia, USA
Jin Montclare, NYU Polytechnic School of Engineering, USA
Aditi Deshpande, University of Arizona, USA
Dimitris Iakovidis, University of Thessaly, Greece
Bhargava Chinni, University of Rochester, USA
Yi Wang, Manhattan College, USA
Angelos Amanatiadis, DUTH, Greece
Martin Nowak, Manhattan College, USA
Anthony Beninati, Manhattan College, USA
James Babilion, Case Western Reserve University, USA
Bing Yu, Marquette University, USA

TC mission – field of expertise (max. 1000 char. Including spaces)

In a rapidly changing global economy, experiencing an unparalleled integration of science and technology with machine learning and artificial intelligence, computer visualization and imaging systems and techniques play an important role in several technological areas. The objective of the TC-19 Technical Committee on Imaging Signals and Techniques is not only to exchange and disseminate knowledge but also bridge multidisciplinary areas like engineering and science with health science, robotics, quantum cognition, exploration of Space and Industry 4.0.; generating new knowledge while establishing global collaborative multidisciplinary opportunities, by tightening collaborations among industry, academia, and healthcare industry. Specifically, the scope of the TC-19 Technical Committee on Imaging Signals and Techniques is to explore multifaceted design principles and new applications of imaging that would lead ultimately to novel devices and technologies, standards and metrology, and systems with unsurpassable image quality, scalability, reconfigurability, and miniaturization capabilities; increase the understanding of pathophysiology and metabolism and measure therapeutic efficacy; bridge technology and clinical disciplines in the multidisciplinary areas of imaging, spectroscopy, machine learning, deep learning, aerospace, industry, and medical diagnostic device industry. The TC-19 provides support to the IMTC Technical conferences, by soliciting technical papers, organizing special sessions and reviewing submitted contributions.

TC meetings in the reporting period^(*)

I. The TC-19 Committee organized together with the IEEE Instrumentation & Measurement Society, The 2021 International Conference on Imaging Systems and Techniques (IST).The event took place jointly with IEEE International School of Imaging in New York (remotely), August 24-26, 2021. This year the IST has been extremely successful

^{*} Please add as many rows as needed

attracting a large number of high-quality papers from all over the world. A series of lectures series was offered through a number of distinguished experts of the field.

II. Professor Giakos has been an invited speaker and chief guest of the Workshop on Machine Vision, sponsored by the National Institute of Technology Jamshedpur, India, July 27-29, 2020. Several eminent speakers from several IIT Institutes from India, and other prestigious international institutions were among the presenters.

III. The TC-19 Technical Committee is being actively involved in the organization of annual 2022 IST (International Conference on Imaging Systems and Techniques), jointly with the International School on Imaging, and the IM Society in Kaohsiung, Taiwan, June 21-23, 2022. Dr. Chi-Hung Hwang serves as the organizer of this prestigious event.

IV. Dr. Georgios Kollias, Research Staff Member (RSM) IBM T.J. Watson Research Center, USA, presented an invited lecture on “Quantum State Tomography: An integrated approach”, sponsored by the IEEE Instrumentation and Measurement Society, TC-19 Technical Committee on Imaging Signals and Systems, and MC Electrical and Computer Engineering.

V. A contributing article reflecting current and novel directions of the TC-19 was submitted to the IMS Magazine and will be published on November 2020 issue.

VI. The Committee have been actively involved in the recruitment, mentoring and promotion of leadership skills of young, enthusiastic engineers. As result, several leading positions are filled with young enthusiastic engineers; as demonstrated by the organization of the IST Conferences and the International School of Imaging.

VII. The Committee has been involved in the peer-review of Proceedings and Transactions papers; assisted in the review process of papers relevant to other IM Conferences and Symposia.

VIII. The Committee organizes one book, on “Multifaceted Imaging Principles and Augmented Intelligence” with the Springer Nature, NY.

Participation in Society sponsored Events (Conferences, Symposia, Workshops) (*)

International Conference on Imaging Systems and Techniques (IST)

The TC-19 Committee actively promotes the International Conference on Imaging Systems and Techniques (IST), a premier conference on Imaging and Computer Visualization, and the IEEE International School on Imaging. The scopes of the IST and the School are to explore multifaceted design principles and new applications of imaging that would lead ultimately to novel devices and technologies, standards and metrology, and systems with unsurpassable image quality, scalability, reconfigurability, and miniaturization capabilities; increase the understanding of pathophysiology and metabolism and measure therapeutic efficacy; bridge technology and clinical disciplines in the multidisciplinary areas of imaging, spectroscopy, machine learning, deep learning, aerospace, industry, and medical diagnostic device industry. The TC-19 provides support to the IMTC Technical conferences, by soliciting technical papers, organizing special sessions and reviewing submitted contributions.

Involvement in standard development(*)

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- Cognitive Vision groups are working towards the development of Figures of Merits (FOM)s for performance assessment of Cognitive Vision Systems, ladars and electrooptical vision systems.
- Polarimetric measurements and metrology as applied to image formation process, image characterization.
- Feature extraction and target motion recognition using cognitive-deep learning architectures and polarimetric principles.
- Underwater vision and imaging-variable illumination-spatial-temporal-frequency response.

Participation in the development of Society Educational Programs^(*)

Program name

International School of Imaging

The International School of Imaging promotes and disseminates fundamental knowledge in the areas of imaging systems and techniques, metrology, imagery instrumentation, image processing and artificial intelligence through a lecture series; offered through Distinguished Key-Note Lecturers.

Undergraduate and Graduate Student Education: The Committee promotes research among undergraduate and graduate students, encouraging joining the Society as student members.

Student Participation into IEEE Conference: several undergraduate and graduate students participate to the IEEE IM sponsored conferences as the IST . Technically sound and original student papers are nominated, then selected for “Best Student Paper Awards”.

Other Activities (tutorials, teaching, career, cooperation, publications, joint activity with chapters or sections) ^(*)

Several of the research/publishing activities, during 2020-21, are presented, namely:

1. Andrzej Skalski, Associate Professor, AGH University of Science and Technology
 - 1) A novel deep learning-based method was proposed to the registration of high-resolution histology images. The method consists of a resolution-independent affine and nonrigid registration in multilevel and multistep framework. The preliminary results were presented during the WBIR 2020 and MICCAI-MLMI 2020 and both the papers achieved The Best Paper Award. The results were published in Computer Methods and Programs in Biomedicine. Ref: <https://doi.org/10.1016/j.cmpb.2020.105799>
https://link.springer.com/chapter/10.1007/978-3-030-50120-4_2
https://link.springer.com/chapter/10.1007/978-3-030-59861-7_49

^{*} Please add as many rows as needed

2) A Contact-Free Multispectral Identity Verification system dedicated to identity verification using palm biometric features was developed and evaluated. We introduce new modality to the system, and we combine it seamlessly with it in a way that is unrecognizable by the user. This approach enhances, for instance, fraud resistance and is new as it comes to the palm vein verification systems. The concept is built on combining NIR and UV modalities and deep learning approach for the feature extraction resulting in a great performance expressed in the True Positive Rate (TPR) achieved by the system when the information from the two modalities were combined was 99.5% by the threshold of acceptance set to the Equal Error Rate (EER).

The results were published in Sensors. Ref: <https://www.mdpi.com/1424-8220/20/19/5695>

3) A method for automatic quality assessment of reflectance confocal microscopy (RCM) images was proposed and evaluated in the context of dermatology images. The method is an end-to-end deep learning algorithm to verify which images have acceptable quality for further processing. The results were presented during IEEE EMBC 2020. Ref: <https://ieeexplore.ieee.org/document/9176557>

4) Our automatic, iterative, multistep procedure scored the 3rd place during the ANHIR challenge (IEEE ISBI). The method is based on combined feature- and intensity-based affine registration followed by nonrigid MIND Demons. The method is the most accurate in terms of median of median TRE among all challenge participants. Ref: <https://ieeexplore.ieee.org/document/9058666>

5) The aim of the work was to develop and implement methods for the prediction and estimation of Parkinson's Disease severity based only on voice signal. We proposed algorithms that were the most accurate to automatically predict the actual symptoms severity of neurodegenerative disease based on the analysis of voice signals. We also took up the challenge of predicting the effects of disease treatment in time. As a result, it was possible to create software which will support the work of the clinician in the field of therapy monitoring and provide a quantitative assessment of treatment results and a forecast of the effects of the therapy in short-term monitoring. The results are described in two papers:

Journal of Voice: [https://www.jvoice.org/article/S0892-1997\(20\)30231-9/abstract](https://www.jvoice.org/article/S0892-1997(20)30231-9/abstract)

Parkinsonism and Related Disorders: [https://www.prd-journal.com/article/S1353-8020\(20\)30360-6/fulltext](https://www.prd-journal.com/article/S1353-8020(20)30360-6/fulltext)

2. Dr. Lijun Xu, Professor, and Coworkers, Beihang University, China.

A. Laser absorption spectroscopy tomography for the combustion field

Aiming at the characteristics of the combustion field, we proposed an anti-noise high-precision spectral extraction method and an image reconstruction method that introduced spectral distribution information and developed a fan-beam laser absorption spectroscopy tomography system. The proposed system has been successfully used for dynamic monitoring of the combustion field at the outlet of a standard high-temperature wind tunnel.

B. Remote Sensing of Forestry using Full-Waveform LiDAR

In forest inventory, it is crucial to generate the dense point clouds from waveform data collected by the airborne full-waveform light detection and ranging (LiDAR). For waveform processing, this group proposes a deconvolution method with (1) an automatic stopping

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criterion to differentiate near-adjacent targets and (2) an iterative false sub-waveform removal algorithm to remove outliers caused by noise.

C. Bladder volume monitoring by electrical impedance tomography

The monitor of the bladder volume is of great significance to patients with impaired perception. Based on the increasing demand on clinical nursing, it is necessary to develop an extracorporeal and non-destructive method to monitor the bladder volume automatically. Therefore, we developed a real-time portable electrical impedance tomography (EIT) system and proposed a partially circular 3D electrode array and a sparse reconstruction method to image the bladder in 3D. Fig. 3 shows the experimental setup in our laboratory. Fig. 2 shows the electrode array and the simulated models of human abdomen and bladder, using cylinder and ellipsoid, respectively. Fig. 4 shows the reconstructed 3D images of the bladders with different volumes using the proposed method, which agree well with the true ones. The electrode configuration and reconstruction algorithm will be further optimized to ensure their performance in future clinical trials.

D. Subsurface abnormality detection based on electrical tomography

Subsurface detection aims to explore the distribution of the underground abnormalities, e.g., landmine and cavity. Planar array electrical tomography (ET) has been studied as a potential subsurface detection method, recognizing the abnormalities by reconstructing the subsurface distribution of abnormalities from boundary electrical measurements. We proposed a 3D image reconstruction method, which combines the depth estimation and 3D sparse representation.

3. Jacob Scharcanski and coworkers, Professor, UFRGS, Brazil

Recently, we developed a new image-based sensor for tracking moving targets that is fully adaptive and self-correcting even in challenging situations like partial occlusions and illumination changes. Recently, the proposed method has been submitted for publication at IEEE Trans. on Instrumentation and Measurement. Also, we are working on a different image-based sensor model for tracking several moving targets simultaneously and we expect to see some results soon.

4. Prof. Zervakis and coworkers, Professor, Technical University of Crete, Greece

Prof. Zervakis, Prof. Giakos, and co-workers published a paper on: “Automated fish cage net inspection using image processing techniques”, IET Image Processing, 2021

The modern trend in aquaculture is to take advantage of IT technologies with the use of a small-sized, low-cost autonomous underwater vehicle, permanently residing within a fish cage and performing regular video inspection of the infrastructure for the entire net surface. In this study, we explore specialized image processing schemes to detect net holes of multiple area size and shape. These techniques are designed with the vision to provide robust solutions.

Prof. Zervakis and coworkers published an article on “Pancreatic Cancer and Its Correlation with Embryogenesis: Identification of Biomolecular Markers Using Machine Learning Methods”, Springer, 2020. the aim of this work is to apply machine learning methods to identify biomolecular markers that are differentially. Other papers:

[1] Polydorou Alexios, Sergaki Eleftheria, Polydorou Andreas, Barbagiannis Christos, Vardiambasis Ioannis, George Giakos, Zervakis Michail, “Improving CAD Hemorrhage Detection in Capsule Endoscopy”, JBiSE Vol.14 No.3 , March 2021.

* Please add as many rows as needed

[8] S Paspalakis, K Moirogiorgou, N Papandroulakis, G Giakos, M Zervakis, Automated fish cage net inspection using image processing techniques IET Image Processing 14 (10), 2028-2034, 2020.

Prof. Giakos and coworkers, Professor, Manhattan College, USA

Prof. Giakos, Dr. Christos Bolakis, and coworkers published a paper on “Design of an optimized multilayer absorber into the MWIR and LWIR bands”, Microwave and Optical Technology Letters, 2021. A new approach for effective detection of infrared (IR) radiation, using an absorber consisting of two successive metal-dielectric layers, has been introduced, described, and discussed.

Prof. Wang, Dr. Giakos, Mr. Nicolas and coworkers published a research paper on “Blockchain System Defensive Overview for Double-Spend and Selfish Mining Attacks: A Systematic Approach”. In this study, a systematic approach aimed at analyzing a total of 40 selected studies using the proposed taxonomy of defensive strategies: monitoring, alert forwarding, alert broadcasting, inform, detection, and conceptual, was employed. IEEE Access. 2020. Other papers:

[1] C Bolakis, C Vazouras, P Michalis, G Giakos, Design of an optimized multilayer absorber into the MWIR and LWIR bands, Microwave and Optical Technology Letters 63 (6), 1669-1676 2021

[2] A. Deshpande, T. Cambria, C. Barnes, A. Kerwick, G. Livanos, M. Zervakis, A. Beninati, N. Douard, M Nowak, J. Basilio], J.L. Cutter, G. Bauman, S. Shrestha, Z. Giakos, Wafa Elmannai, Yi Wang, P. Foroutan, T. Farrah], and G.C. Giakos , "Fluorescent Imaging and Multifusion Segmentation for Enhanced Visualization and Delineation of Glioblastomas Margins", “Journal on Signals”, Special Issue on “Biosignals Processing and Analysis in Biomedicine”, 2021 (invited)-fees \$2,600 waved.

[3]M. Nowak, A. Beninati, N. Douard, A. Puran, C. Barnes, A. Kerwick and G.C. Giakos, Polarimetric Dynamic Vision Sensor p(DVS) Neural Network Architecture for Motion Classification, Electronic Letters, 2021.

[4] K Nicolas, Y Wang, GC Giakos, B Wei, H Shen, Blockchain System Defensive Overview for Double-Spend and Selfish Mining Attacks: A Systematic Approach, IEEE Access, 2020

[5] M Nowak, A Beninati, N Douard, GC Giakos, Polarimetric dynamic vision sensor p (DVS) principles, IEEE Instrumentation & Measurement Magazine 23 (8), 18-23, 2020

[6] OM Igwe, Y Wang, GC Giakos, J Fu, Human activity recognition in smart environments employing margin setting algorithm, Journal of Ambient Intelligence and Humanized Computing, 1-13, 2020

Recommended candidates^(*)

Type (ADCOM, Fellow, Award – specify-)	First Name	Second Name	Family Name	Affiliation /Address	Motivation

* Please add as many rows as needed

TC operating Plan: near-term plans for the upcoming year, including scheduled meetings, activities, and so on (max. 1000 char. Including spaces)

The TC-19 Technical Committee is being actively involved in the organization of annual 2022 IST (International Conference on Imaging Systems and Techniques), jointly with the International School on Imaging, and the IM Society in Kaohsiung, Taiwan, June 21-23, 2022. Dr. Chi-Hung Hwang serves as the organizer of this prestigious event.

Several talks are planned through the IEEE NY Local Chapter on Instrumentation and Measurement.

Collaboration with Indian colleagues, through conferences and Special Issues are planned.

TC operating plan: long term vision from 2-5 years out, based on IMS Strategic Plan, including areas of strength, areas for improvement, how is the subject area going to change, planned actions for lifting achievement succession plans etc. (max. 1000 char. Including spaces)

Expansion of the Committee into the Southern Eastern Asia.

Strengthen it's presence in US.

The TC-19 operates through a Committee-shared leadership model aimed at retaining and rewarding active members and high performers, while promoting scholarship and dissemination of new imaging principles. To meet this goals, several leading positions are filled with young enthusiastic engineers; as demonstrated, during all these years, by the organization of the IST Conferences and the International School of Imaging.

* Please add as many rows as needed

TC convergence, synergy, cooperation with other TC, from I&M or other societies (max. 1000 char. Including spaces)

The TC-19 Committee on Imaging Signals and Systems has established collaborative efforts with the IEEE NY Chapter, IEEE Systems, Man, Cybernetics (SMC) Society, IEEE Computer Society through their respective local NYC Chapters. It is not accidental the fact that during the IST 2021, that took place remotely at NYC, August 24-26 2021, all the above societies worked synergistically, with remarkable efforts, making the IST another successful event.

Comments/Suggestions (max. 1000 char. Including spaces)

It should be desirable to explore as part of recruitment incentives, how can we assume part of the fees associated with first-year student memberships.

How can we encourage and promote conferences/symposia organized synergistically by a number of technical committees?

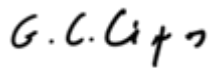
Promote student competitions and awards, at different geographical areas.

Respectfully

George Giakos, Ph.D.

Fellow of the IEEE

Distinguished Faculty Fellow Office of Naval Research (ONR)



Professor

Department of Electrical and Computer Engineering

Manhattan College, NY

