IEEE JOURNAL OF

BIOMEDICAL AND HEALTH INFORMATICS

Proposal for a Special Issue/Section

Proposal Title

Advancing Biomedical Discovery and Healthcare Delivery Through Digital Technologies

Keywords

Artificial intelligence, data analytics, data intelligence, deep learning, clinical information systems, cloud computing for health care, health information systems, body sensor networks, sensors and sensor systems, bioinformatics for health monitoring, integrated solutions for pandemics, biomedical technologies in treating emergencies, digital health

Proposers' Information (Names, affiliations, and contact information)

Sergio Cerutti
DEIB Department, Politecnico di Milano, Italy
sergio.cerutti@polimi.it

Bjorn Eskofier
Friedrich-Alexander University Erlangen-Nuernberg, Germany
bjoern.eskofier@fau.de

Georgia Tourassi
Oak Ridge National Laboratory
tourassig@ornl.gov

Introduction and General Justification

The digital revolution has been transforming biomedicine across the whole continuum, from scientific discovery to clinical translation and healthcare delivery. The rapid advances in artificial intelligence coupled with new data generation technologies and new hardware accelerators are influencing the biomedical discovery process, from data-driven hypothesis generation, to design of virtual experiments, to generating surrogate models of complex biological and healthcare systems, to automating healthcare delivery.

The proposed topic of this Special Issue addresses advances in all aspects of intelligent health and informatics systems. This is a trending area with innovative data analytics approaches and technological advances produced at a rapid pace. We view this Special Issue as a timely forum within which the current state-of-the-art can be captured. Furthermore, the proposed topic should be viewed as being applicable to BSN and BHI audiences, which complement each other through advances in informatics and systems, respectively. This Special Issue also provides an opportunity for submissions that capture the end-to-end view of solutions that use advanced digital technologies to address key healthcare scenarios, including the present pandemic of COVID-19, which was hardly predictable.

IEEE JOURNAL OF

BIOMEDICAL AND HEALTH INFORMATICS

Focus (topics/focus areas)

The Proposed Special Issue will focus on novel digital techniques and their application to biomedical discovery and healthcare delivery. We intend to capture papers that cover not only new algorithmic advances in sensing, storage, communication and data processing but also their impact on existing and emerging healthcare problems, even the ones related to the current COVID-19 pandemic.

Topics for this Special Issue include, but are not limited to

- AI techniques applied to sensing, transfer and storage of biomedical data
- AI techniques applied to health informatics
- Distribution, storage and sharing of biomedical data for AI
- Systems that use AI to address existing and novel clinical applications
- Efficient design of AI algorithms for bioinformatics in the cloud and on the edge
- Enabling technologies of computing, databases, devices, imaging, sensors, and systems
- Integrating clinical, organisational and technological items to provide proper responses to modern medical care
- The role of AI techniques in dealing with global emergencies and the COVID-19 pandemic.

Why a Special Issue is Required

In recent years, digital technologies have emerged as a key area in biomedical science with potential to revolutionize healthcare delivery by optimizing and often minimizing human intervention in personal and clinical health care. Further, it is necessary to integrate various interventions which in most of the cases are separated, like clinical, organisational, managemental and technological aspects which need to be fused into a unique framework for a more efficient operationalization. A Special Issue that highlights successes and challenges in the use of digital technologies, including AI, for accelerating biomedical discovery and advancing healthcare delivery would be highly valuable to promote future work in this area and help researchers understand the clinical implications of failure in key health care applications. In addition, contributions dealing with the management of the COVID-19 pandemic are encouraged. This is a timely and innovative subject that attracts the attention of both the BHI and BSN communities.

Guest Editors (Names, affiliations, and contact information)

Same as proposers. Find information above.

Reference to Any Past or Forthcoming Scientific Event if Relevant

- IEEE BHI 2021
- IEEE BSN 2021
- IEEE EMBC 2021

IEEE JOURNAL OF

BIOMEDICAL AND HEALTH INFORMATICS

Biographies of the Guest Editors (Provide a biography of up to one page for each Guest Editor, including a list of five most relevant publications and highlight if there is any journal editorial or conference organisation experience.)

- **Sergio Cerutti** is Emeritus Professor at the Politecnico in Milano where he carries out his research and didactical activities in the area of Advanced Biomedical Signals Analysis at the Department of Electronics, Information and Bioengineering (DEIB). In previous years, at the same Politecnico, he has been i) Chairman of the Bachelor Track (Diploma Universitario) in Biomedical Engineering (1996-2000), ii) Head of the Department of Bioengineering (2000-2006) and iii) Chairman of the Programs of Biomedical Engineering (1st and 2nd level Degrees in Biomedical Engineering) (2010-2012).

  His research activity is mainly dedicated to various aspects of biomedical signal, data processing and modelling related to the field of neurosciences as well as in cardiovascular and autonomic nervous system applications. More recently, he dedicated himself also to Biomedical Imaging, Fusion of Biosignals with Medical Images and Bioinformatics, i.e. the applications of modelling techniques and data processing to the strings of information contained in the DNA, RNA and in proteomics data as well. His characteristic vision of scientific research is finding out how it is possible to enhance information from data and biomarkers obtained from Biosignals, Bioimages and Bioinformatics, by using algorithms typical of modern information processing.

  He is the Author of more than 650 indexed international scientific contributions (about 350 on indexed scientific journals, according to ISI). His h-Index is 75 (Google Scholar). His most cited paper is the Task Force on HRV, 1996, one of the most cited papers on Circulation, over 16,000 overall citations:
  Camm J, Malik M., Bigger J.T., Breithardt G., Cerutti S. et al., Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability: standards of measurement, physiological interpretation and clinical use. Circulation 1996; 93: 1043-65, European Heart Journal 1996, 17, n.3:354-381

  He has coordinated or was involved in various research projects at national and international levels in various topics of Biomedical Engineering and Bioinformatics. The most recent ones funded by European Union are: My-Heart, Heart Cycle, Psyche, Link.

  He spent over a year as a Visiting Professor at the MIT and Harvard School of Public Health, Boston MA, USA, in the '80's, as well as a period of 4 months at the Department of Physics of the IST (Instituto Superior Tecnico), Technical University in Lisbon, Portugal, in 2008, where he was invited for helping in the kick-off phase of Master and Doctorate degrees in Biomedical Engineering.

Since 2004 he is Chairman of EMB18, Italian IEEE Chapter on Engineering in Medicine and Biology. He is also Chairman of the Biomedical Engineering Group of Italian AEIT (Association of Electrical Engineering and Telecommunication), affiliated to IEEE.

He is a Fellow member of IEEE, AIMBE and EAMBES, the most important scientific Institutions in the area of Biomedical Engineering and member of other international and national technical & scientific Associations. From 1980 to 2016 he has been Chairman of the Italian Sub-Committee 62D - Electromedical Equipment - of CEI (Italian Regulation & Standardisation Body associated to IEC-International Electrotechnical Commission). From 2016 he is Chairman of Technical Committee TC62 – Electrical equipment in medical practice of CEI.

In the period 1993-1996 he has been Representative of Region8 (Europe, Africa and Middle East) at the Advisory Committee (AdCom) of IEEE-EMB Society and has been re-elected in the period 2011-2016. He has been Member of the International Scientific Committee of the various Annual Conferences of IEEE-EMBS since 1988. He has been Chairman of Regional Conference and of Technical Activity Committees of the same Society. He is Chairman of the Ethical Committee of "Istituto Europeo di Oncologia (IEO)" and "Centro Cardiologico Monzino" in Milano. He is also Member of the Ethical Committee of the Politecnico di Milano from its foundation in 2016.

In 2009 he received the IEEE-EMBS Academic Career Achievement Award, the most important scientific acknowledgement to the scientific career issued by IEEE. In 2010 he received the Milan Ambassador Award in recognition of his scientific activity finalized to the organization of important Conferences and initiatives in the Conference Center of the City of Milano.

He is in the Editorial Board of various journals in Biomedical Engineering area: in particular he is Associate Editor of IEEE Transactions on Biomedical Engineering and Physiological Measurements and he is in the editorial board of Medical Engineering & Physics, Biomedical Signal Processing & Control, Medical and Biological Engineering & Computing, Annals of Non- Invasive Electrocardiology, Critical Reviews in Biomedical Engineering, etc.

Since 1995 he has been the organiser of 6 IEEE-EMBS International Summer Schools on Advanced Biomedical Signal Processing held in Siena and in Pavia as well as of Biosignal Interpretation Conferences (BSI). In 2015 he has been the Conference Chair of the 37th Annual Conference of IEEE-EMBS in Milano (more than 3270 registrants).

He is a Member of the Group of the Best Italian Scientists (with h-Index $\geqslant$ 30), scoring a h-index of 75, at 20th position inside "Engineering" topic at national level (2021) and with a documented number of citations of more than 51,000.

IEEE JOURNAL OF

BIOMEDICAL AND HEALTH INFORMATICS

- LIST OF RECENT PAPERS

1) Maggioni, E., Arienti, F., Minella, S., Mameli, F., Borellini, L., Nigro, M., Cogiamanian, F., Bianchi, A.M., Cerutti, S., Barbieri, S., Brambilla, P., Ardolino, G. Effective Connectivity During Rest and Music Listening: An EEG Study on Parkinson's Disease (2021), Frontiers in Aging Neuroscience,13

2) Tassi, E., Maggioni, E., Cerutti, S., Brambilla, P., Bianchi, A.M A novel spatiotemporal tool for the automatic classification of fMRI noise based on Independent Component Analysis (2020), Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBS2020-July, pp.1718-1721.

3) Reali, P., Lolatto, R., Stefano, P.D., Cerutti, S., Bianchi, A.M. Investigating the Optimal Baseline Positioning to Maximize Cognitive Experimental Outcome (2019), Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBS, pp.4529-4532.

4) De Maria, B., Bari, V., Cairo, B., Vaini, E., Esler, M., Lambert, E., Baumert, M., Cerutti, S., Dalla Vecchia, L., Porta, A. Characterization of the asymmetry of the cardiac and sympathetic arms of the baroreflex from spontaneous variability during incremental head-up tilt (2019), Frontiers in Physiology, (APR),n.10

5) Reali, P., Tacchino, G., Rocco, G., Cerutti, S., Bianchi, A.M. Heart rate variability from wearables: A comparative analysis mong standard ECG, a smart shirt and a wristband, (2019), in Studies in Health Technology and Informatics, 261,pp.128-133.

6) De Maria, B., Bari, V., Ranucci, M., Pistuddi, V., Ranuzzi, G., Takahashi, A.C.M., Catai, A.M., Dalla Vecchia, L., Cerutti, S., Porta, A. Separating arterial pressure increases and decreases in assessing cardiac baroreflex sensitivity via sequence and bivariate phase-rectified signal averaging techniques, (2018), Medical and Biological Engineering and Computing, 56(7),pp.1241-1252.

7) Trujillo, P., Summers, P.E., Smith, A.K., Smith, S.A., Mainardi, L.T., Cerutti, S., Claassen, D.O., Costa, A. Pool size ratio of the substantia nigra in Parkinson's disease derived from two different quantitative magnetization transfer approaches (2017), Neuroradiology,59(12),pp.1251-1263.

8) De Pasquale, M., Moss, T.J., Cerutti, S., Calland, J.F., Lake, D.E., Moorman, J.R., Ferrario, M. Hemorrhage prediction models in surgical intensive care: Bedside monitoring data adds information to lab values (2017), IEEE Journal of Biomedical and Health Informatics, 21(6), pp.1703-1710.

9) Maggioni, E., Zucca, C., Reni, G., Cerutti, S., Triulzi, F.M., Bianchi, A.M., Arrigoni, F. Investigation of the electrophysiological correlates of negative BOLD response during intermittent photic stimulation: An EEG-fMRI study, (2016), Human Brain Mapping, 37(6), pp.2247-2262.

10) Sclocco, R., Beissner, F., Desbordes, G., Polimeni, J.R., Wald, L.L., Kettner, N.W., Kim, J., Garcia, R.G., Renvall, V., Bianchi, A.M., Cerutti, S., Napadow, V., Barbieri, R. Neuroimaging brainstem circuitry supporting cardiovagal response to pain: A combined heart rate variability/ultrahigh-field (7 T) functional magnetic resonance imaging study, (2016), Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, (16 May): 20150189

- **Bjoern Eskofier** is German Research Foundation (DFG) funded Heisenberg-Professor for "Digital Support Systems in Sports and Medical Engineering". He heads the Machine Learning and Data Analytics (MaD) Lab and the Central Institute for Medical Engineering at the Friedrich-Alexander-University Erlangen-Nuernberg (FAU), and he is the current speaker of FAU's Department Artificial Intelligence in Biomedical Engineering (AIBE). Currently, his lab has 40 co-workers, who research in the fields of machine learning and signal analysis for ubiquitous computing systems in sports and health care. The motivation of the lab's researchers is to increase human wellbeing.
  Dr. Eskofier studied Electrical Engineering at the FAU and graduated in 2006. He then studied under the supervision of Prof. Dr. Benno Nigg at the University of Calgary (Canada). There, he received his PhD degree in Biomechanics in 2010 for his research on "Application of Pattern Recognition Methods in Biomechanics". He authored more than 240 peer reviewed articles, submitted 5 patent applications, and started three spinoff startup companies. He won several medical-technical research awards. In 2016, he was a visiting professor in Dr. Paolo Bonato's Motion Analysis Lab at Harvard Medical School (February-March), and in 2018, he was a visiting professor in Dr. Alex "Sandy" Pentland's Human Dynamics group at MIT Media Lab (March-August). He is also a delegate of the FAU to the Medical Valley (80 Mio Euro German Ministry of Education funded cluster) and to the European Institute of Innovation & Technology for Health (EIT Health).
  Bjoern Eskofier has defined his research and entrepreneurial agenda to revolve around contributions to a "Digital Health Ecosystem", where patients are connected to other stakeholders within the Healthcare system using digital support tools. His digital health research philosophy is that only multidisciplinary teams of engineers, medical experts, industry representatives and entrepreneurs will have the tools to actually implement changes in Healthcare

  Bjoern has involvement with the following editorial roles:
  - Associate Editor, IEEE "Journal of Biomedical and Health Informatics"
  - Associate Editor, IEEE "Open Access Journal of Engineering in Medicine and Biology"
  - Associate Editor, Frontiers in "Sports and Active Living"

  Conference Chair:
  - Dagstuhl Seminar on "Modeling and simulation of sport games, sport movements, and adaptations to training", 2015, Germany
  - BSA Conference 2013 – Biosignal Analysis", Universidade Federal do Rio de Janeiro, Brazil

  Conference co-Chair
  - International Conference on Biomedical and Health Informatics (BHI 2021)
  - International Symposium on Wearable Computers (ISWC 2021)
  - International Symposium on Wearable Computers (ISWC 2020)

- International Symposium on Wearable Computers (ISWC 2019)
- TC Member and Organization, "Fifth Intl. Symposium on Automated Sensor Based Mobility Analysis for Prevention and Disease Treatment", Body Sensor Networks Conference, BSN 2018
- TC Member and Organization, "Fourth Intl. Symposium on Automated Sensor Based Mobility Analysis for Prevention and Disease Treatment", Body Sensor Networks Conference, BSN 2016

Recent Publications

1) Gassner H, Jensen D, Marxreiter F, Kletsch A, Bohlen S, Schubert R, Muratori LM, **Eskofier BM**, Klucken J, Winkler J, Reilmann R, Kohl Z. *Gait variability as digital biomarker of disease severity in Huntington's disease*. **Journal of Neurology**, doi:10.1007/s00415- 020-09725-3, 2020.

2) Nguyen A, Roth N, Haji Ghassemi N, Hannink J, Seel T, Klucken J, Gassner H, **Eskofier BM**. *Development and clinical validation of inertial sensor-based gait-clustering methods in Parkinson's disease*. **Journal of Neuroengineering and Rehabilitation**, doi:10.1186/s12984-019-0548-2, 2019.

3) Hannink J, Kautz T, Pasluosta CF, Barth J, Schülein S, Gaßmann KG, Klucken J, **Eskofier BM**. *Mobile Stride Length Estimation with Deep Convolutional Neural Networks*. **IEEE Journal of Biomedical and Health Informatics** 22(2), 354-362, 2018.

4) Antunes RS, Seewald L, Rodrigues V, Costa C, Gonzaga L, Righi R, Maier A, **Eskofier BM**, Ollenschläger M, Naderi F, Bauer S, Klein S, Fahrig R, Campanatti G. *A Survey of Sensors in Healthcare Workflow Monitoring*. **ACM Computing Surveys** 51(2), 42:1-37, 2018.

5) Espay AJ, Bonato P, Nahab F, Maetzler W, Dean JM, Klucken J, **Eskofier BM**, Merola A, Horak F, Lang AE, Reilmann R, Giuffrida J, Nieuwboer A, Horne M, Little MA, Litvan I, Simuni T, Dorsey ER, Burack MA, Kubota K, Kamondi A, Godinho C, Daneault JF, Mitsi G, Krinke L, Hausdorff JM, Bloem BR, Papapetropoulos S. *Technology in Parkinson disease: Challenges and Opportunities*. **Movement Disorders** 31(9), 1272-1282, 2016.

6) Kautz T, **Eskofier BM**, Pasluosta C. *Generic Performance Measure for Multiclass- Classifiers*. **Pattern Recognition** 68, 111-125, doi: 10.1016/j.patcog.2017.03.008, 2017.

7) Pasluosta CF, Gassner H, Winkler J, Klucken J, **Eskofier BM**. *An Emerging Era in the Management of Parkinson's disease: Wearable Technologies and the Internet of Things*. **IEEE Journal of Biomedical and Health Informatics** 19(6), 1873-1881, 2015.

8) Rampp A, Barth J, Schulein S, Gassmann K.-G, Klucken J, **Eskofier BM**. *Inertial sensor based stride parameter calculation from gait sequences in geriatric patients*. **IEEE Transactions on Biomedical Engineering**, 62(4), 1089-1097, 2015.

9) Leutheuser H, Schuldhaus D, **Eskofier BM**. *Hierarchical, multi-sensorbased classification of daily life activities: comparison with state-of-the-art algorithms using a benchmark dataset*. **PLoS ONE**, 8(10), e75196, 2013.

10) **Eskofier BM**, Federolf P, Kugler P, Nigg BM. *Marker-based classification of young-elderly gait pattern differences via direct PCA feature extraction and SVMs*. **Computer Methods in Biomechanics and Biomedical Engineering**, 16(4), 435-442, 2013.

- **Georgia Tourassi** is the Director of the National Center for Computational Sciences at the Oak Ridge National Laboratory (ORNL). Concurrently, she holds appointments as an Adjunct Professor of Radiology at Duke University and as a joint UT-ORNL Professor of the Bredesen Center Data Science Program at the University of Tennessee at Knoxville. Her scholarly work includes 13 US patents and innovation disclosures and more than 260 peer-reviewed journal articles, conference proceedings articles, editorials, and book chapters. She is elected Fellow of the American Institute of Medical and Biological Engineering (AIMBE), the American Association of Medical Physicists (AAPM), the International Society for Optics and Photonics (SPIE), and the American Association for the Advancement of Science (AAAS). Her research interests include high performance computing and artificial intelligence in biomedicine. For her leadership in the Joint Design of Advanced Computing Solutions for Cancer initiative, she received the DOE Secretary's Appreciation Award in 2016. In 2017, she received the ORNL Director's Award for Outstanding Individual Accomplishment in Science and Technology and the UT-Battelle Distinguished Researcher Award. In 2020, Dr. Tourassi received the DOE's Secretary Honors Award for her contributions to the COVID 19 Insights Partnership Team and to the COVID 19 HPC Resource Team.

  Conference and Editorship Involvement (since 2018):

  - Associate Editor, IEEE Journal of Biomedical and Health Informatics (2020 – now)
  - Associate Editor, IEEE Access (2019 – now)
  - IEEE International Conference on Biomedical and Health Informatics - Technical Committee Co-Chair (2018,2019,2020)
  - SPIE Medical Imaging Conference – Elected Lead Chair of the Full International Symposium (2020)
  - SPIE Medical Imaging Conference – Elected Co-Chair of the Full International Symposium (2019)
  - SPIE Medical Imaging Conference – CAD Committee Program Member (2010-2021)
  - 2018 Organizer of a workshop on "Computational Phenomics at Scale: From Supercomputers to Bedside" for the 2018 Supercomputing Conference, Dallas, TX (November 16, 2018)

  Recent publications

Elemento, C. Leslie, J, Lundin, & G.D. Tourassi, (2021). Artificial intelligence in cancer research, diagnosis, and therapy. Nature Reviews Cancer, 1-6.

- H. Gerlovin, …, G.D. Tourassi, & K. Cho. "Pharmacoepidemiology, Machine Learning and COVID-19: An intent-to-treat analysis of hydroxychloroquine, with or without azithromycin, and COVID-19 outcomes amongst hospitalized US Veterans." American Journal of Epidemiology (2021)
- S. Dhaubhadel, J. Mohd-Yusof, K. Ganguly, G. Chennupati,…, G.D. Tourassi, ... & T. Bhattacharya. "Why I'm not Answering: An Abstention-Based Approach to Classify Cancer Pathology Reports." arXiv e-prints, arXiv-2009 (2021).
- H.J. Yoon, H. Klasky, C. Stanley, J.B. Christian, G.D. Tourassi, E.B. Durbin,… & L. Penberthy. "Privacy-Preserving Knowledge Transfer with Bootstrap Aggregation of Teacher Ensembles.", (2021). 87. M. Alawad, S. Gao, M.C. Shekar, S.M. Hasan, J.B. Christian, X.C. Wu, ... & G.D. Tourassi, "Integration of Domain Knowledge using Medical Knowledge Graph Deep Learning for Cancer Phenotyping." arXiv preprint arXiv:2101.01337 (2021).
- K. De Angeli, S. Gao, M. Alawad, H.J. Yoon, N. Schaefferkoetter, X.C. Wu,…, & G.D. Tourassi, "Deep active learning for classifying cancer pathology reports." BMC bioinformatics, 22(1), 1-25 (2021).
- S. Gao, M. Alawad, M.T. Young, J. Gounley, N. Schaefferkoetter, H.J. Yoon, X.C. Wu,…, & G.D. Tourassi, "Limitations of Transformers on Clinical Text Classification." IEEE Journal of Biomedical and Health Informatics (2021).
- M. Stewart, C. Rodriguez-Watson, A. Albayrak, G.D. Tourassi,…, & Allen, J. (2021). COVID-19 Evidence Accelerator: A parallel analysis to describe the use of Hydroxychloroquine with or without Azithromycin among hospitalized COVID-19 patients. Plos one, 16(3), e0248128 (2021).
- H-J. Yoon, H. Klasky, J. Gounley, M. Alawad, S. Gao, J.B. Christian, G. Tourassi, L. Penberthy, X. Wu, E.Durbin, A. Stroup, J. Doherty. "Accelerated Training of Bootstrap Aggregation-based Deep Information Extraction Systems from Cancer Pathology Reports" Journal of Biomedical Informatics 110: 103564 (2020).
- S. Gao, M. Alawad, N. Schaefferkoetter, …, G.D. Tourassi, "Using case-level context to classify cancer pathology reports" PLOS one 15.5: e0232840 (2020) 81. M. Alawad, S. Gao,…, Tourassi.G.D. "Privacy-Preserving Deep Learning NLP Models for Cancer Registries". IEEE Transactions on Emerging Topics in Computing doi: 10.1109/TETC.2020.2983404 (2020)
- Hasan S., J.B. Christian,…, G.D. Tourassi, "Knowledge Graph-Enabled Cancer Data Analytics," IEEE Journal of Biomedical and Health Informatics, 24(7), 1952-1967 (2020)

IEEE JOURNAL OF

BIOMEDICAL AND HEALTH INFORMATICS

KEY DATES

Deadline for Submission: 15 February, 2022
First Reviews Due: 31 March, 2022
Revised Manuscript Due: 15 May, 2022
Final Decision: 30 June, 2022