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Data Harmonization: An Imaging-driven omics database/repository for retrospective understanding of COPD and planning for future care

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(**details are listed on the last page**)

Zoom : https://pitt.zoom.us/j/9630638972

Abstract: Consistent imaging protocols will require normalization / harmonization of data sourced from multiple platforms, hospitals and vendors. AI has shown a remarkable ability to generalize and group / tease out patterns from high-dimensional data. Machine / deep learning algorithms should rely on mix-omics integration of imaging and physiological measures. There is an urgent need for new models of multi-modal transfer learning (e.g., understanding lung and heart functional interactions), and incremental learning as cohorts grow at an ever-faster face, combining data from states/countries.

We are in the process of developing harmonization methods that are applied to COPD patient imaging data. This phenotyping could lead to a better retrospective understanding of COPD disease pathways and prepare for future management of pulmonary-derived chronic pathologies. In addition, there are significant new chronic pathologies expected in COVID survivors (cardiomyopathy, pulmonary aspergillosis, hemoglobin / iron deficiencies) in the longer term, which will be challenging to treat and / or recognize. The harmonized baseline data during acute phases of disease would help tremendously in our ability to understand the implications of these pathologies.

The proposed harmonization platform would include normalization across vendors, sites, possible variations in protocols and patient size. We describe AI based harmonization methods to leverage a large number of baseline scans from existing and ongoing studies for density measures, texture and later airway topology. During this initial phase, the Columbia cohort would harmonize 2,500 subjects in total, sampling in proportion five distinct cohorts. In the long term we aspire to develop data sharing tools, with possible partnerships for long term / global infrastructure and computing, integrate expertise in multiple imaging modalities, lead an open AI approach to model, predict and understand stages of pulmonary disease including COPD.

Biosketch: Andrew F. Laine received his D.Sc. degree from Washington University (St. Louis) School of Engineering and Applied Science in Computer Science, in 1989 and BS degree from Cornell University (Ithaca, NY). He was a Professor in the Department of Computer and Information Sciences and Engineering at the University of Florida (Gainesville, FL) from 1990-1997. He joined the Department of Biomedical Engineering in 1997 and served as Vice Chair of the Department of Biomedical Engineering at Columbia University since 2003 – 2011, and Chair of the Department of Biomedical Engineering (2012 – 2017). He is currently Director of the Heffner Biomedical Imaging at Columbia University and the Percy K. and Vida L. W. Hudson Professor of Biomedical Engineering and Professor of Radiology (Physics).

He has served on the program committee for the IEEE-EMBS Workshop on Wavelet Applications in Medicine in 1994, 1998, 1999, and 2004. He was the founding chair of the SPIE conference on “Mathematical Imaging: Wavelet

Application in Signal and Image Processing", and served as co-chair during the years 1993-2003. Dr. Laine has served as Chair of Technical Committee (TC-BIIP) on Biomedical Imaging and Image Processing for EMBS 2004-2009, and has been a member of the TC of IEEE Signal Processing Society, TC-BISP (Biomedical Imaging and Signal Processing) 2003 - present. Professor Laine served on the IEEE ISBI (International Symposium on Biomedical Imaging) steering committee, 2006-2009 and 2009 -2012. He was the Program Chair for the IEEE EMBS annual conference in 2006 held in New York City and served as Program Co-Chair for IEEE ISBI in 2008 (Paris, France). He served as Area Editor for IEEE Reviews in BME in Biomedical Imaging since 2007-2013. He was Program Chair for the EMBS annual conference for 2011 (Boston, MA). Professor Laine Chaired the Steering committee for IEEE ISBI, 2011-2013, and Chairs the Council of Societies for AIMBE (American Institute for Medical and Biological Engineers). He was the General Co-Chair for IEEE ISBI in 2022. Finally, he served as the IEEE EMBS Vice President of Publications 2008 – 2012, and was the President of IEEE EMBS (Engineering in Biology and Medicine Society) 2015 and 2016. He is a Fellow of IEEE, AIMBE and IFMBE.

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