

The logo for ismict'16 features the text "ismict'16" in a white, lowercase, sans-serif font. Above the "i" is a white Wi-Fi symbol consisting of three curved lines. The text is underlined with a white horizontal line.

IEEE 10th International Symposium on Medical Information
and Communication Technology (ISMICT)
March 20 – March 23, 2016
Worcester Polytechnic Institute, Massachusetts, USA

Advanced Program

<http://www.ismict2016.org>

NOTES

PROGRAM AT A GLANCE

The 10th International Symposium on Medical Information and Communication Technology (ISMICT'16) will focus on 2 parallel tracks ISMICT'16 features Keynote Sessions, Technical Sessions, Workshops and Industry Panels. Please see below for the basic program outline

Sunday, 20 March 2016			
Time	Event & Location		
12:00-14:00	Conference Registration Odeum A/B		
14:00-17:00	Tutorial: Modern Full-Body Human CAD Models for Microwave Simulations Gregory Noetscher, US Army Natick RDE Labs, Sara Louie, ANSYS Inc and Sergey Makarov, ECE Department, WPI Hagglund		
18:30-20:30	Opening Reception Odeum C		
Monday, 21 March 2016			
Time	Event & Location		
9:00-9:10	Opening Talk Kaveh Pahlavan/Vahid Tarokh, General Chairs Bruce Burnsten, Provost, WPI Odeum A/B		
9:10-10:00	Keynote Speech I Bringing Life to Engineering: NIH Programs on Tissues-on-Chips and SPARC Neuromodulation Speaker: Danilo Tagle, Associate Director for Special Initiatives Odeum A/B		
10:00-10:30	Coffee Break Lobby, Campus Center		
10:30-12:30	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">Technical Session 1 BAN technology: PHY and MAC protocols Odeum A/B</td> <td style="width: 50%; text-align: center;">Technical Session 2 Medical BAN applications and services Hagglund</td> </tr> </table>	Technical Session 1 BAN technology: PHY and MAC protocols Odeum A/B	Technical Session 2 Medical BAN applications and services Hagglund
Technical Session 1 BAN technology: PHY and MAC protocols Odeum A/B	Technical Session 2 Medical BAN applications and services Hagglund		
12:30-14:00	Panel I: Securing Medical Cyber-Physical Systems: Challenges and Future Directions Organizer: K. K. Venkatasubramanian, CS Department, WPI lunch box at Odeum A/B		
14:00-15:20	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">Technical Session 3 Antennas and radio propagation for wireless BAN Odeum A/B</td> <td style="width: 50%; text-align: center;">Technical Session 4 Rehabilitation and activity monitoring Hagglund</td> </tr> </table>	Technical Session 3 Antennas and radio propagation for wireless BAN Odeum A/B	Technical Session 4 Rehabilitation and activity monitoring Hagglund
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15:30-16:30	Transportation from WPI to MIT Campus Center (Bus leave at 15:30 sharp)		
16:30-18:00	Panel II: Medical Device Safety Co-Session with MIT Partnership for a Systems Approach to Safety (PSAS) Annual Conference, Organizer: N. Leveson, A&A Department, MIT MIT Stata 52-123, 32 Vassar St., Cambridge, MA		
19:00-22:00	Evening Social Event MIT Museum, MIT Campus, Cambridge/Boston		

IEEE ISMICT 2016 – WORCESTER/BOSTON

International Symposium on Medical Information and Communication Technology

PROGRAM AT A GLANCE

Tuesday, 22 March 2016	
Time	Event & Location
9:00-12:30	Workshop I/Panel III: Challenges and Future Directions in Medical Device Regulatory Science (MDRS) Organizer: M. Fujise and R. Kohno Odeum A/B
12:30-14:00	Panel IV: Building an Internet of Medical Things - Connecting Data Sources with FHIR API's Requirements for Gene and Cell Therapy Organizer: S. Miles, MIT Center for Biomedical Innovation lunch box at Odeum A/B
14:00-16:00	Workshop II: Workshop on Recent Advances on Video Capsule Endoscopy Organizer: M. Kanaan, Erciyes University H. Farhadi, Visiting Scholar at Harvard University Odeum A/B
	Technical Session 5: Wireless Capsule Endoscopy I Odeum A/B
16:00-16:30	Coffee Break Lobby, Campus Center
16:30-17:50	Technical Session 6 Wireless Capsule Endoscopy II Odeum A/B
19:00-21:00	Honors VIP Dinner Sponsored by Skyhook, Boston Organizer: V. Tarokh, Harvard University Higgins House
Wednesday, 23 March 2016	
Time	Event & Location
9:00-10:00	Technical Session 7 Medical imaging and patient diagnostic systems Odeum A/B
	Technical Session 8 Medical signal processing Hagglund
10:00-10:30	Coffee Break Lobby, Campus Center
10:30-12:30	Technical Session 9 Pervasive health care and patient monitoring Odeum A/B
	Technical Session 10 Privacy and security issues Odeum A/B
	Technical Session 11 Indoor Patient Localization Hagglund
12:30	Closing Remarks (optional lunch)

GENERAL INFORMATION - FLOOR PLANS AND MAPS

2D MAP OF WORCESTER POLYTECHNIC INSTITUTE (WPI) (The Main Venue of ISMICT 2016)



CAMPUS STRUCTURES

- 1 Air Force and Aerospace Studies
- 2 Alden Memorial
- 3 Alumni Gym
- 4 Atwater Kent Laboratories
- 5 Bartlett Center
- 6 Boynton Hall
- 7 Campus Center
- 8 Campus Police
- 9 Collegiate Religious Ctr
- 10 20 Trowbridge Road
- 11 Fuller Laboratories
- 12 Gateway Phase II
- 13 Goddard Hall
- 14 Gordon Library
- 15 Hackfeld House
- 16 Harrington Auditorium
- 17 Health Center
- 18 Higgins House
- 19 Higgins Laboratories
- 20 Hughes House
- 21 International House
- 22 Jeppson House (One Drury Lane)
- 23 Kaven Hall
- 24 OASIS

- 25 Olin Hall
- 26 37 Lee Street
- 27 Power House
- 28 Project Center
- 29 Salisbury Laboratories
- 30 Skull Tomb
- 31 Sports & Recreation Center
- 32 Stratton Hall
- 33 Student Development and Counseling Center
- 34 Washburn Shops and Stoddard Laboratories
- 35 WPI Life Sciences and Bioengineering Center
- 85 Prescott Street

Campus Map

STUDENT RESIDENCES

- A Daniels Hall
- B 16 Elbridge
- C Ellsworth Apartments
- D Founders Hall
- E Fuller Apartments
- F 26 Hackfeld
- G Institute Hall
- H Morgan Hall
- J Sanford Riley Hall
- K 22 Schussler
- L Stoddard Complex
- M 25 Trowbridge
- N East Hall
- O Salisbury Estates
- P 10 Faraday

GREEK HOUSES

- G1 Alpha Chi Rho
- G2 Alpha Gamma Delta
- G3 Alpha Tau Omega
- G4 Alpha Xi Delta
- G5 Lambda Chi Alpha
- G6 Phi Gamma Delta
- G7 Phi Kappa Theta
- G8 Phi Sigma Kappa
- G9 Phi Sigma Sigma
- G10 Sigma Alpha Epsilon
- G11 Sigma Phi Epsilon
- G12 Sigma Pi
- G13 Tau Kappa Epsilon
- G14 Theta Chi
- G15 Zeta Psi
- G16 Alpha Phi

KEY

- Campus Structures
- Student Residences
- Greek Houses
- Parking



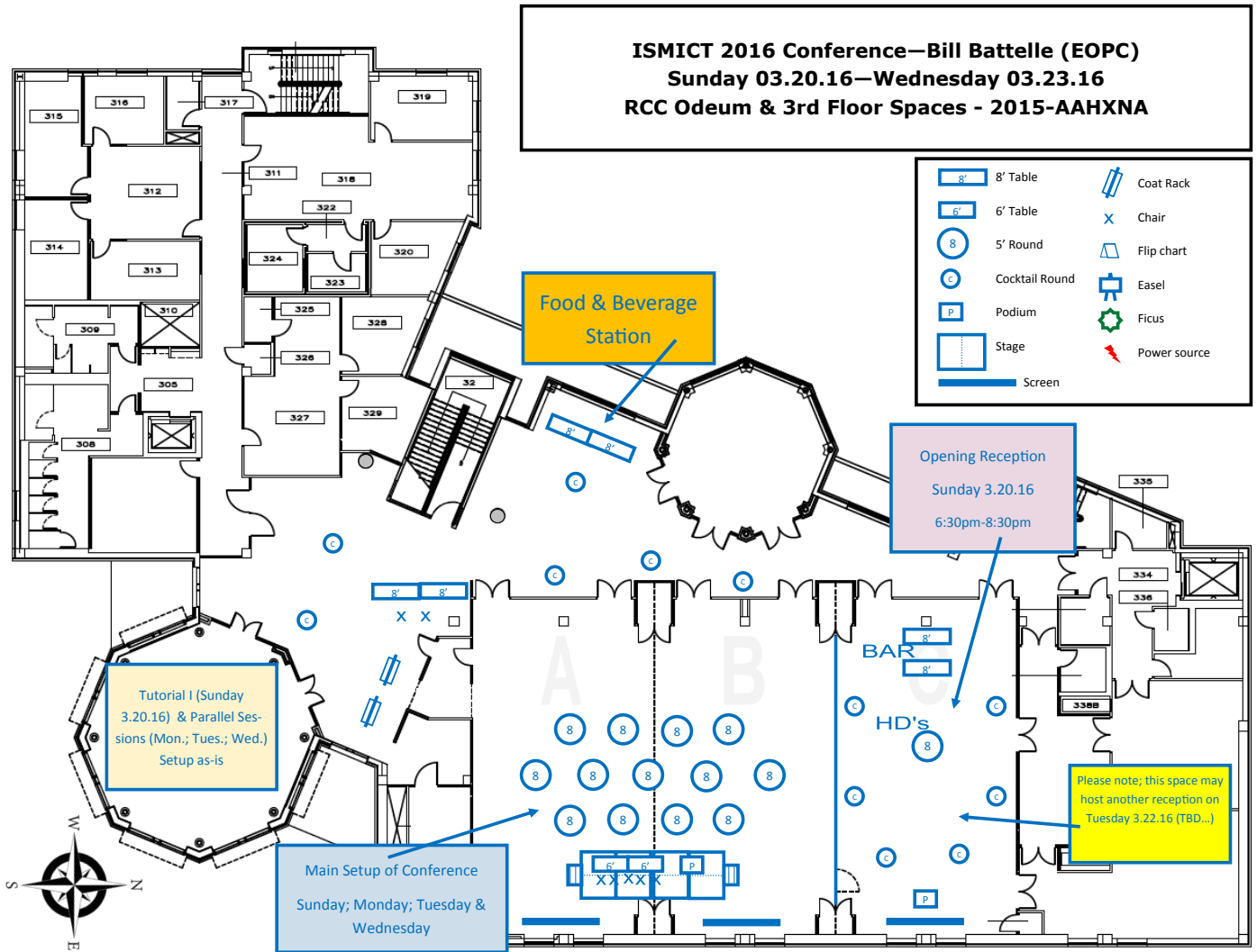
Transportation to/from MIT
Coach pick-up on 15:30,
Monday, March 21.

WPI Campus Center
The Main Venue for ISMICT 2016.

WPI Higgins House
The Honors VIP Dinner for ISMICT 2016.

GENERAL INFORMATION -FLOOR PLANS AND MAPs

3rd FLOOR OF WPI RUBIN CAMPUS CENTER (The Main Venue of ISMICT 2016)

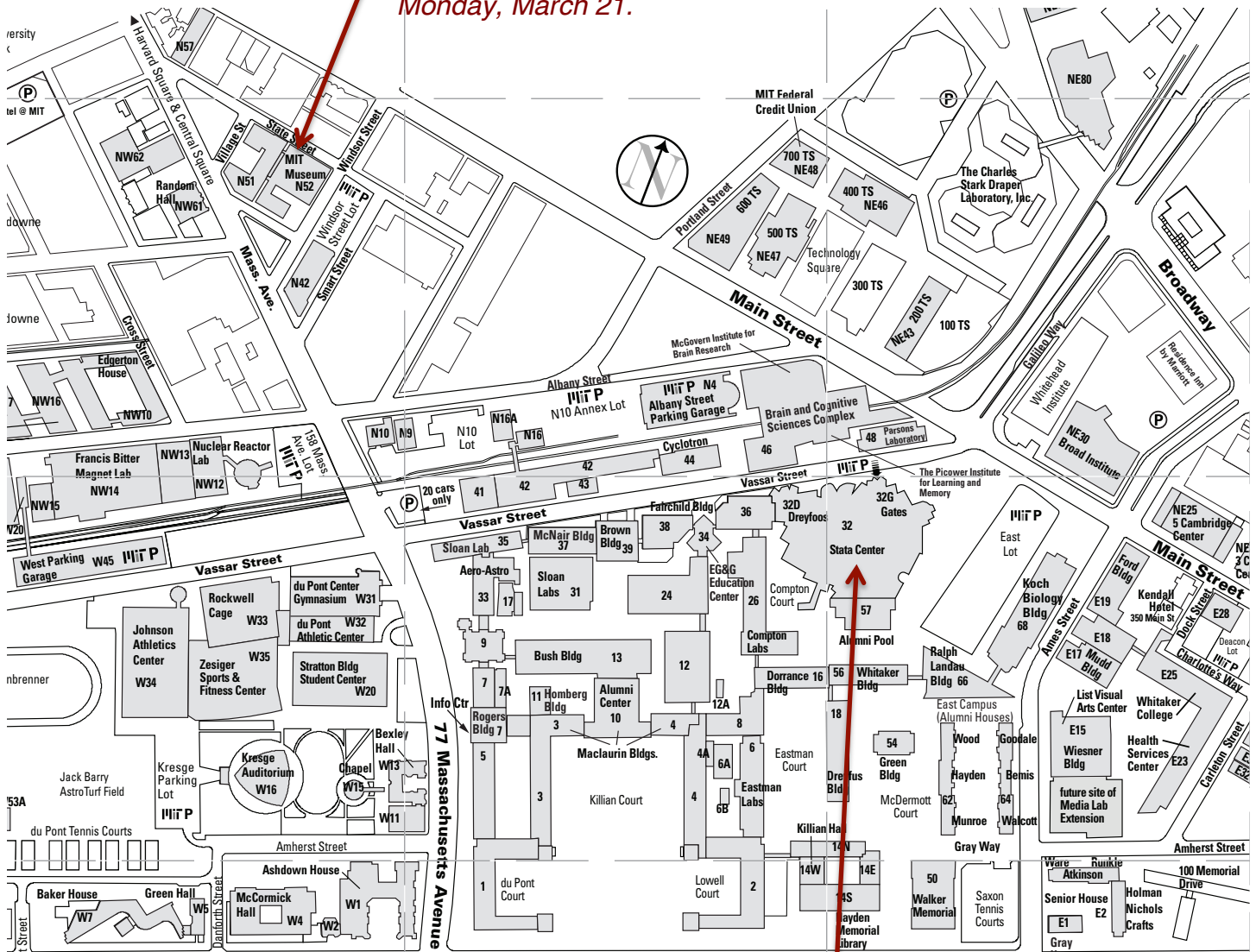


GENERAL INFORMATION - FLOOR PLANS AND MAPS

2D MAP OF MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT) (The Joint Venue of ISMICT 2016)

MIT Museum

Evening Social Event on Monday March 21.
Coach pick-up on Mass. Ave. on 21:00,
Monday, March 21.



MIT Stata Center

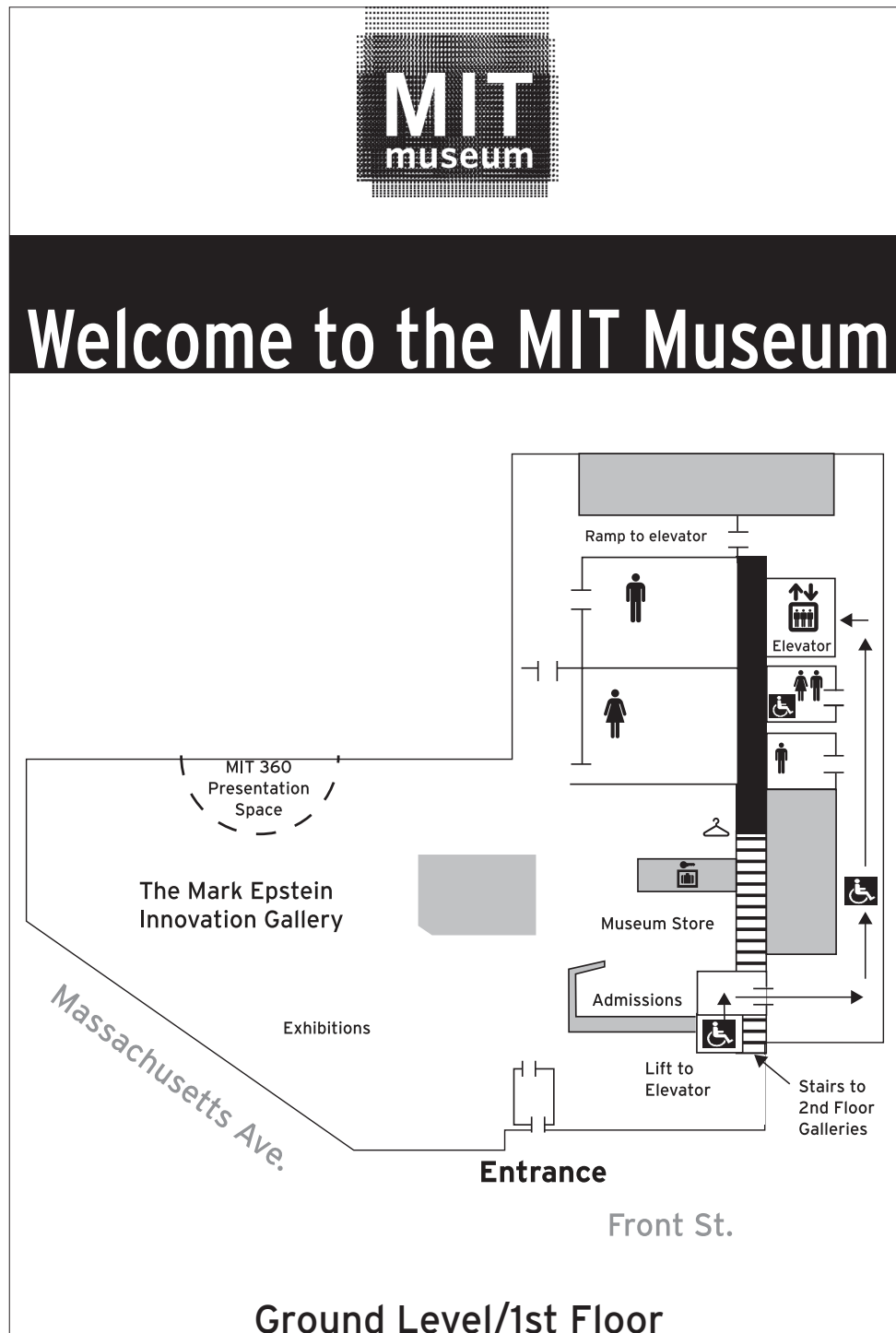
Panel II, on Monday March 21
Coach drop-off on Vassar St.

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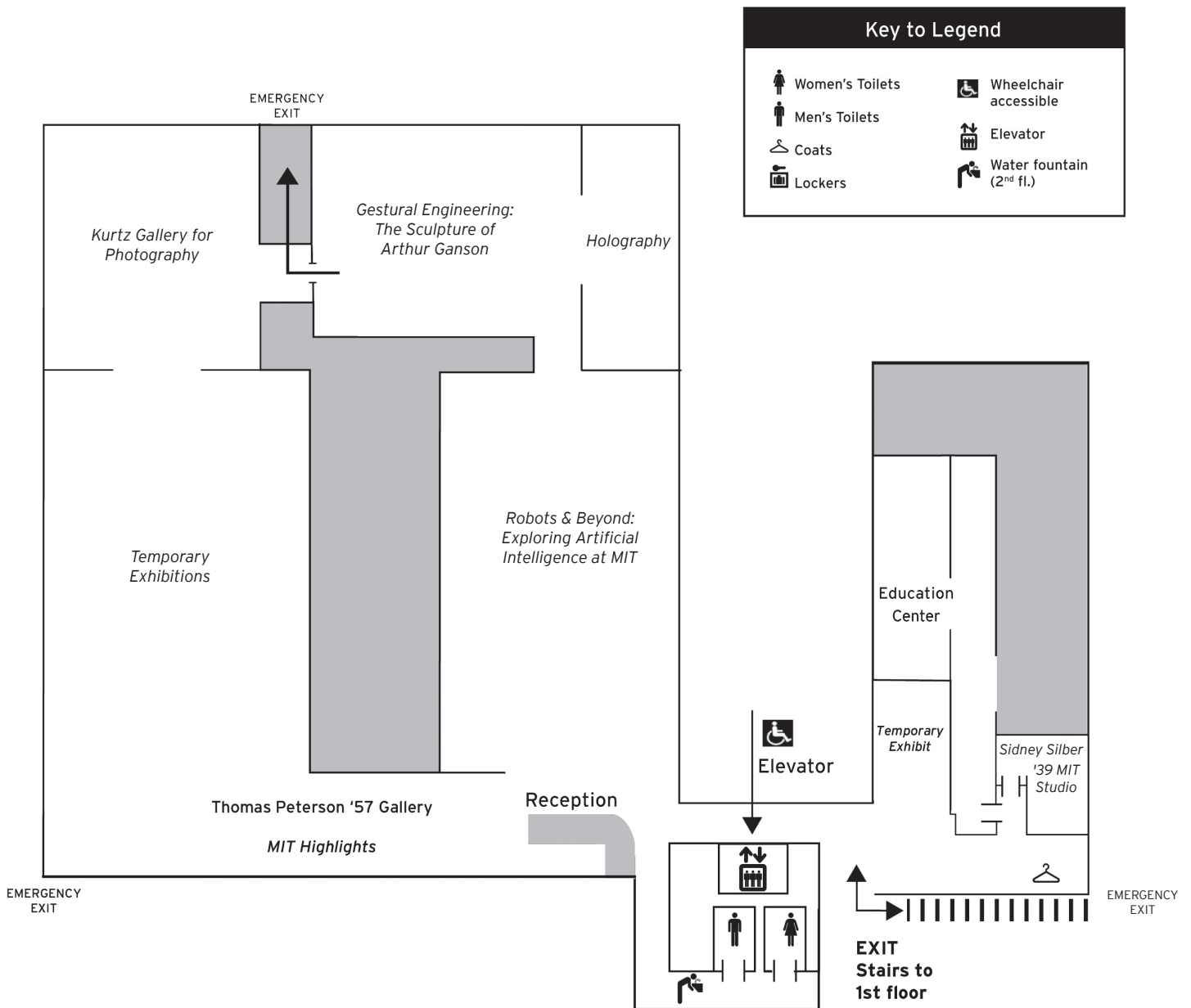
GENERAL INFORMATION -FLOOR PLANS AND MAPS

1st FLOOR OF MIT MUSEUM (The Special Event of ISMICT 2016)



GENERAL INFORMATION -FLOOR PLANS AND MAPs

2nd FLOOR OF MIT MUSEUM (The Special Event of ISMICT 2016)



GENERAL INFORMATION - MEALS

OPENING RECEPTION

Sunday, March 20, 18:30-20:30

Finger Food and Cocktail

Room: Odeum C

LUNCH

Monday, March 21, 12:30-14:00

Standard Lunch Boxes

Room: Odeum A/B

DINNER

Monday, March 21, 19:00-22:00

Banquet/Evening Social Event

Room: MIT Museum

LUNCH

Tuesday, March 22, 12:30-14:00

Standard Lunch Boxes

Room: Odeum A/B

DINNER (invited honors VIP)

Tuesday, March 22, 19:00-22:00

KavehFest

Room: Higgins House

GREETINGS FROM THE GENERAL CHAIRS



It is a pleasure and honor to welcome you to the Massachusetts and the 2016 Tenth International Symposium on Medical Information and Communication Technology (ISMICT).

This occasion marks the second occurrence of the ISMICT in the United States. In keeping with its history of global diversity in participants and organizations, this Tenth ISMICT offers an outstanding program with technical papers, a tutorial, six keynote speeches, two workshops, and four panel discussions, which reflects the truly global view of the emerging technologies in medical information. We have tried to strike a balance among the diverse interests of the academia, the industry, and the regulatory aspects both in composition of the organizing committee and in the technical content of the program. To encourage quality of research, the symposium has allocated a best paper award, which will be presented at the social event in the MIT Museum.

The main venue of the ISMICT 2016 is at the Worcester Polytechnic Institute (WPI). A Special Session in Medical Device Safety is coordinated with STAMP 2016 at Massachusetts Institute of Technology (MIT) in Cambridge. The Social Event will also be held at the MIT Museum.

Boston area is renowned for its beautiful college and university campuses, historical and charming neighborhoods, inviting parks and walkways, and selection of diversified restaurant and shopping centers. Worcester is a college town located in the west of Boston with over 35000 students in ten colleges and universities. WPI's scenic campus was planned by Calvert Vaux, a protégé of the famous landscape architect Frederick Law Olmstead.

We are sure that our strong technical program and the charm and attraction of historical New England will create an enjoyable experience for all participants in the conference.

Kaveh Pahlavan

Vahid Tarokh

General Co-chairs, ISMICT 2016

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GREETINGS FROM THE TECHNICAL PROGRAM CHAIRS



We would like to welcome all the participants to ISMICT 2016, organized in lovely Worcester, MA. We hope that all of you will enjoy the technical program we have.

The first day of the conference presents a tutorial course to provide an occasion to the participants to broaden their understanding of radio propagation inside and around the human body, which is essential for most medical applications related to the information and communication technologies. We are assuming that the use of wireless body area networks (WBAN) will become larger in the coming years, which requires good understanding on close body propagation mechanisms and how to model and simulate those.

The next three days include eight keynote speeches, four panel discussions and two workshops. The eleven technical presentation sessions are also distributed in the last three days of the conference. This diversified technical program describes the latest research, development, and new concepts in various aspects of medical information and communication technology. Altogether, the conference will accommodate 40 technical papers which have been selected after a peer review process.

On Monday, we will provide you an insight on neuromodulation and tissues-on-chips via Keynote speech. Then after we have four technical sessions covering the topics on protocols, antennas, propagations, applications and services relating to WBAN. In addition, we will cover patient monitoring. The ISMICT 2016 Conference and STAMP 2016 Workshop will also organize a Medical Device Safety Co-Session in Massachusetts Institute of Technology (MIT) where ISMICT participants are taken.

Tuesday is mainly focused on medical device regulatory science (MDRS) and wireless capsule endoscopy (WCE). Both themes will be covered in Workshops. There will also be a panel discussion on MDRS. In addition, we will organize a panel on Internet of medical things.

Wednesday will conclude ISMICT 2016 with five technical sessions. Topics of the day will cover medical imaging and diagnostic systems, medical signal processing, privacy and security issues, patient monitoring and indoor localization.

As can be seen from the technical program, ISMICT 2016 will cover important topics related to future personalized healthcare, and can utilize modern ICT technology. TPC Co-Chairs will give all the gratitude to the volunteering TPC members who have carefully read the submitted papers and evaluated those to keep the technical level of the conference high.

Hamed Farhadi, Matti Hämäläinen and Esmaeil Nadimi
TPC Co-Chairs, ISMICT 2016

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ORGANIZING COMMITTEE

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Worcester Polytechnic Institute, MA, USA

Vahid Tarokh

Harvard University, MA, USA

ISMICT Advisor

Ryuji Kohno

Yokohama National University, Yokohama, Japan

Technical Program Chairs

Hamed Farhadi

Harvard University, MA, USA

Matti Hamalainen

University of Oulu, Oulu, Finland

Esmaeil Nadimi

University of Southern Denmark, Denmark

Workshop Chairs

Masayuki Fujise

Yokohama National University, Yokohama, Japan

Stephen Miles

Massachusetts Institute of Technology, MA, USA

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Worcester Polytechnic Institute, MA, USA

Vahid Tarokh

Harvard University, MA, USA

Emmanuel Agu

Worcester Polytechnic Institute, MA, USA

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Yuzhang Zang

Worcester Polytechnic Institute, MA, USA

KEYNOTE SPEAKERS AND KEYNOTE SESSIONS

Monday, March 21 (9:10-10:00) Room: Odeum A/B

Opening Keynote: Bringing Life to Engineering: NIH Programs on Tissues-on-Chips and SPARC Neuromodulation

Speaker:

Danilo A. Tagle

Ph.D., Associate Director for Special Initiatives, NCATS, NIH



Bio:

Dan Tagle is associate director for special initiatives at NCATS. He also recently served as acting director of the NCATS Office of Grants Management and Scientific Review and currently serves as executive secretary to the NCATS Advisory Council and Cures Acceleration Network Review Board. Prior to joining NCATS, Tagle was a program director for neurogenetics at the National Institute of Neurological Disorders and Stroke (NINDS), where he was involved in developing programs concerning genomics-based approaches for basic and translational research in inherited brain disorders.

Prior to joining NINDS in 2001, Tagle was an investigator and section head of molecular neurogenetics at the National Human Genome Research Institute and has been involved in the highly collaborative effort toward the positional cloning of genes for Huntington's disease, ataxia-telangiectasia and Niemann-Pick disease type C. He has served on numerous committees and advisory boards, including the editorial boards of the journals *Gene* and the *International Journal of Biotechnology*. Tagle obtained his Ph.D. in molecular biology and genetics from Wayne State University School of Medicine in 1990. He was an NIH National Research Service Award postdoctoral fellow in human genetics in the laboratory of Francis S. Collins, M.D., Ph.D., at the University of Michigan. Tagle has authored more than 150 scientific publications and has garnered numerous awards and patents.

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KEYNOTE SPEAKERS AND KEYNOTE SESSIONS

Tuesday, March 22 (9:10-9:40) Room: Odeum A/B

Keynote I: Medical Device Regulatory Science: A View from 20 Years at FDA's Device Center

Speaker:

Gregory Campbell

formerly FDA, USA



Bio:

Gregory Campbell has served as the Director of the Division of Biostatistics in the Office of Surveillance and Biometrics of Center for Devices and Radiological Health (CDRH) of the Food and Drug Administration (FDA) for 20 years until he retired from the U.S. government in the summer of 2015. With a Ph.D. in Mathematical Statistics from Florida State University and after serving on the faculty in the Department of Statistics at Purdue University and at the National Institutes of Health, Dr. Campbell led a group at FDA of about 60 statisticians that provided support to CDRH as a whole and, in particular, the statistical reviews of FDA's pre-market device submissions that led to the approval of a large number of innovative medical devices and diagnostics. He pioneered the innovative implementation in a regulatory environment of Bayesian statistics, methods for observational studies, and adaptive designs. He is a Fellow of the American Statistical Association and a recipient of the FDA Award of Merit. Dr. Campbell served in many statistical leadership positions and has been instrumental in the recent establishment of the Medical Device and Diagnostics Section of the American Statistical Association. His research interests include the evaluation of diagnostic tests (including microarrays) as well as statistical issues in clinical trials.

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KEYNOTE SPEAKERS AND KEYNOTE SESSIONS

Tuesday, March 22 (9:40-10:10) Room: Odeum A/B

Keynote II: Finding and Protecting Medical Grade Spectrum to Advance Health

Speaker:

Michael Marcus

Marcus Spectrum Solutions LLC



Bio:

Michael Marcus is a native of Boston and received S.B. and Sc.D. degrees in electrical engineering from MIT. Prior to joining the FCC in 1979, he worked at Bell Labs on the theory of telephone switching, served in the U.S. Air Force where he was involved in underground nuclear test detection research, and analyzed electronic warfare issues at the Institute for Defense Analyses. At FCC his work focused on proposing and developing policies for cutting edge radio technologies such as spread spectrum/CDMA and millimeterwaves. Wi-Fi is one outcome of his early leadership. The total amount of spectrum he proposed for unlicensed use and directed the drafting of implementing rules was 8.234 GHz. He also participated in complex spectrum sharing policy formulation involving rulemakings such as ultrawideband and MVDDS. Awarded a Mike Mansfield Fellowship in 1997, he studied the Japanese language and spent a year at the FCC's Japanese counterpart. He retired from FCC in March 2004 after servicing a senior technical advisor to the Spectrum Policy Task Force and codirecting the preparation of the FCC's cognitive radio rulemaking. Immediately after retirement he lived in Paris France for 3 years, consulting for US and European clients. In 2006 he was appointed Special Advisor to Mrs. Viviane Reding, European Commissioner for Information Society & Media.

He is now Director of Marcus Spectrum Solutions LLC, an independent consulting firm based in the Washington DC area and focusing on wireless technology and policy. He is also Adjunct Professor of Electrical and Computer Engineering at Virginia Tech and the 2011-2013 chair of the IEEE-USA Committee on Communications Policy. He was recognized as a Fellow of the IEEE "for leadership in the development of spectrum management policies", received in 1994 IEEE-USA's first Electrotechnology Transfer Award, and received in 2013 the IEEE ComSoc Award for Public Service in the Field of Telecommunications "For pioneering spectrum policy initiatives that created modern unlicensed spectrum bands for applications that have changed our world."

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KEYNOTE SPEAKERS AND KEYNOTE SESSIONS

Tuesday, March 22 (12:40-13:10) Room: Odeum A/B

Keynote III: SMART API Using HL7 FHIR Emerging Standards to Define Patient Data Resources

Speaker:

Josh Mandel

Lead Architect, SMART Health IT, Boston Children's Hospital and Harvard Medical School



Bio:

Josh Mandel is a physician and software developer working to fuel an ecosystem of health apps with access to clinical data. After earning an S.B. in computer science and electrical engineering from the Massachusetts Institute of Technology and an M.D. from the Tufts University School of Medicine, he joined the Harvard Medical School Department of Biomedical Informatics. Josh Mandel serves as lead architect for SMART Health IT (<http://smarthealthit.org>) and is a member of the national Health IT Standards Committee. Josh Mandel also served as the community lead for the national Blue Button REST API. He has a special interest in tools and interfaces that support software developers who are new to the health domain.

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KEYNOTE SPEAKERS AND KEYNOTE SESSIONS

Tuesday, March 22 (13:10-13:40) Room: Odeum A/B

Keynote IV: “OpenEpic”

Speaker:

Janet Campbell

Vice President of Patient Experience, Epic



Bio:

Janet Campbell is a software developer and Vice President of Patient Engagement at Epic, which creates enterprise medical records for mid-size and large medical groups, hospitals, and integrated healthcare organizations. In her thirteen years at Epic, Janet has led the creation and development of several products and initiatives, including open.epic, a plug & play initiative to integrate and embed outside health apps and other innovations within Epic using standard technologies such as SMART and FHIR. She represents Epic in national conversations on interoperability, usability, meaningful use, and patient engagement. She is Chair of the Electronic Health Record Association's Clinical Experience Workgroup and has been a member of several U.S. government advisory working groups focusing on standards for exchange.

A native of Kentucky, Janet graduated with a Bachelors of Arts in Computer Science from Carleton College in Northfield, Minn. She currently lives in Madison, Wis., where she enjoys running and photography, though usually not at the same time.

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KEYNOTE SPEAKERS AND KEYNOTE SESSIONS

Tuesday, March 22 (14:10-14:35) Room: Odeum A/B

Keynote V: Video Capsule Endoscopy - A Disruptive Technology

Speaker:

David R Cave

Director of G.I Research/Professor of Medicine, University of Massachusetts Medical School



Bio:

David Cave is a Professor of Medicine at the University of Massachusetts Medical School and on the faculty of UMass Memorial Medical Center working in the Department of Internal Medicine and Division of Gastroenterology and Chief of Clinical Gastroenterology Research. He was previously Professor of Medicine at Tufts University Medical Center. His research interests are focused on imaging of the small intestine and the etiology of inflammatory bowel disease. He obtained both his MD and PhD at St George's Hospital Medical School, University of London. Since 2001 Dr. Cave has worked with multiple companies to optimize the world wide clinical development of video capsule endoscopy along with deep enteroscopic techniques. He has authored 2 books on these technologies and more 100 original articles on related fields.

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KEYNOTE SPEAKERS AND KEYNOTE SESSIONS

Tuesday, March 22 (14:35-15:00) Room: Odeum A/B

Keynote VI: Technological Considerations for Future Wireless Video Capsule Endoscopy

Speaker:

Ilangko Balasingham

Professor/Head of Biomedical Sensor Network Research Group, Intervention Center, Oslo University Hospital



Bio:

Ilangko Balasingham received the M.Sc. and Ph.D. degrees from the Department of Electronics and Telecommunications, Norwegian University of Science and Technology (NTNU), Trondheim in 1993 and 1998, respectively, both in signal processing. He performed his Master's degree thesis at the Department of Electrical and Computer Engineering, University of California Santa Barbara, USA. From 1998 to 2002, he worked as a Research Scientist developing image and video streaming solutions for mobile handheld devices at Fast Search & Transfer ASA, Oslo, which is now Microsoft Development Center Norway. Since 2002 he has been with the Intervention Center, Oslo University Hospital, as a Senior Research Scientist, where he heads the Wireless Sensor Network Research Group. He was appointed as a Professor in Signal Processing in Medical Applications at NTNU in 2006. His research interests include super robust short range communications for both in-body and on-body sensors, body area sensor network, microwave short range sensing of vital signs, short range localization and tracking mobile sensors, and nano-neural communication networks. He has authored or co-authored more than 200 papers and has been active in organizing special sessions and workshops on wireless medical technology at the major conferences and symposiums. He was the General Chair of the 2012 Body Area Networks (BODYNETS) and TPC Chair of the 2015 ACM NANOCOM conferences and serves as Area Editor of Elsevier Nano Communication Networks. He is a Senior IEEE member.

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TUTORIALS, WORKSHOPS AND INDUSTRIAL PANELS

Monday, March 21 (12:30-14:00) Room: Odeum A/B

Panel I: Securing Medical Cyber-Physical Systems: Challenges and Future Directions

Organizer/Moderator: Krishna K. Venkatasubramanian (CS Dept. WPI)

Panelists:

Eugene Vasserman, (Kansas State University, USA)

David Arney, (Partners Inc., USA)

Melissa Chase, (MITRE, USA)

Recent years have seen an explosion in the diversity of medical cyber-physical systems (MCPS) that are becoming available for managing a variety of healthcare issues. From interoperable medical device systems in ICUs to tele-surgery robots to wearable and ingestible technologies, MCPS are making it possible for healthcare to be pervasive, autonomous, and effective.

Much work has been going on in designing MCPS to be safe, especially in the cases where the underlying system components fail. However, the safety-critical nature of MCPS (e.g., closed-loop actuation capabilities) makes them obvious targets for exploitation by adversaries. The failures from such exploitation usually have features that are inherently different from models of failures that MCPS designers typically assume.

Therefore, preserving MCPS operation under adversary-induced failures is essential for ensuring patient safety. In this panel, we will discuss several important questions in this regard including what are the appropriate threat models for the MCPS? Are existing network and system attack prevention, detection, and response solutions sufficient for MCPS? What roles can data-driven models play in dealing with the inherent complexity of MCPS and developing effective security solutions for them? Can we leverage work done in the fault-tolerance and robust control domain to alleviate some of these problems? How can we make MCPS resilient, and continue their often critical operations, during attacks?

The panel seeks to debate and seek various viewpoints on these questions. The discussion of this panel will be relevant to anyone interested in designing secure MCPS. "

Monday, March 21 (16:30-18:00) Room: MIT Stata 52-123

Panel II: Medical Device Safety Co-Session with MIT Partnership for a Systems Approach to Safety (PSAS) annual conference

Organizer/Moderator: Nancy Leveson (Director, MIT: Systems Thinking and Medical Device Safety)

Panelists:

Todd Pawlicki, (University of California San Diego, USA)

Kristie Chung, (Beacon Health Options Inc., USA)

This joint panel with IEEE ISMICT2016 focuses on application of systems and control-theory based hazard analysis to medical device design, most notably for those devices that are connected, and provides a model for the design, evaluation, regulation and use by service providers and patient care communities.

STAMP is a new accident causality model based on systems theory and systems thinking described in Nancy Leveson's book "Engineering a Safer World." STAMP integrates into engineering analysis the causal factors in our

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TUTORIALS, WORKSHOPS AND INDUSTRIAL PANELS

increasingly complex systems such as software, human-decision making and human factors, new technology, social and organizational design, and safety culture.

STPA is a powerful new hazard analysis technique based on STAMP while CAST is the equivalent for accident/incident analysis. This free workshop will provide attendees with the opportunity to learn how to use these new tools, to meet with users and to hear about applications, evaluations, and the latest developments in this powerful new approach to system safety engineering and to cyber security in the context of medical devices that are increasingly connected.

Tuesday, March 22 (9:00-12:30) Room: Odeum A/B

Workshop I/Panel III: Challenges and Future Directions in Medical Device Regulatory Science

Organizer/Moderator: Ryuji Kohno (Yokohama National University, Japan)

Masayuki Fujise, (Yokohama National University, Japan)

Panelists:

Lorenzo Mucchi, (University of Florence, Italy)

Henry Chang, (IBM T.J. Watson Research Center, USA)

Gregory Campbell, (formerly FDA, USA)

Michael Marcus, (Marcus Spectrum, USA)

This panel presents new research and development results in the area Medical Device Regulatory Science (MDRS) with a focus on the safe and reliable application of advanced technologies in information communications technology, biology and medical engineering.

In Medical ICT research topics may range from RF Frequencies and protocols to scientific approaches to the analysis of medical device safety data. Recent years have seen an explosion in the diversity of software defined radio systems (SDR) that are becoming available for managing a variety of healthcare issues. In Japan, new Multi-mode and Multi-Service Software Radio Communication Systems are being developed by companies such as NTT, Toshiba, CRL, Sony/Textronix, Toyo Communication and Anritsu and as are being tested at Yokohama National University. These systems range from 1.5 and 1.6/1.9/5.8 GHz bands to 2.45GHz band RF frequencies. Further, physical layer wireless security has been a research topic in light of the safety-critical nature of MCPS (e.g., closed-loop actuation capabilities), which must be protected.

In order to develop leading-edge combined ICT medical and healthcare systems such as wireless-enabled (BAN) medical devices and to support their certification, a variety of methods to quantitatively assess the efficacy and risk based on the scientific data are necessary. One obvious example can be Big Data analysis: In clinical trials, traditional (frequentist) statistical methods traditionally used information from previous studies only at the design stage. Then, at the data analysis stage, the information from these studies was considered as a complement to, but not part of, the formal analysis. Today regulators are applying Bayesian ideas to consider prior information and the trial results as part of a continual data stream, in which inferences are being updated each time new data become available.

Bio-Medical Science research may range from novel nanoparticles and their derivatives effect on cell differentiation, new methodologies for biomarkers detection, to novel systems for synthesizing biomarkers for reducing stress to the human body. In this panel, we will discuss regulatory best practices for preserving RF

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TUTORIALS, WORKSHOPS AND INDUSTRIAL PANELS

Frequencies for healthcare applications, internal and external to the human body. Are existing network and system standards and best practices sufficient for MCPS? What roles can data-driven models play in dealing with the complexity of MCPS and developing effective solutions for them? The panel seeks to debate and seek various viewpoints on these questions.

Tuesday, March 22 (12:30-14:00) Room: Odeum A/B

Panel IV: Building an Internet of Medical Things – Connecting Data Sources with FHIR API's - Protocol/Interoperability Requirements for Cell and Gene Therapy

Organizer/Moderator: Stephen Miles (MIT Center for Biomedical Innovation)

Panelists:

Josh Mandel, (Boston Children's Hospital and Harvard Medical School, USA)

Janet Campbell, (Epic, USA)

Myriam Armant, (Boston Children's Hospital and Dana Farber Cancer Institute, USA)

Jacqueline Wolfrum, (MIT Center for Biomedical Innovation, USA)

Jeremy Kolenbrander, (TerumoBCT, USA)

Autologous chimeric antigen T-cell (CAR-T) therapies are generating remarkable remissions in hard-to-beat blood cancers, and have the potential to treat a wide variety of other cancers, as well. The starting materials for these therapies are stem cells, which are harvested in the hospital from the patient to be treated. The patient has typically previously undergone multiple failed treatment regimens. Additionally, a variety of protocols can be used to prepare the patient for the stem cell harvest. These factors, which are part of the patient record, could significantly impact the quality of the apheresis product used for CAR-T manufacturing. The current CAR-T manufacturing process is characterized by a high degree of variability, and access to information regarding factors affecting the quality of the patient's apheresis could be used to optimize the manufacturing protocols for these personalized cell therapy products.

This panel includes perspectives from Clinical Research, Process Control and Healthcare IT perspectives on new and emerging protocol requirements for what information clinicians/researchers need to access in patient records and how this information can be used to optimize delivery of autologous cell and gene therapy products to critically ill patients. Further discussion of what data from this product/process, in association with a Unique Identifier, should be saved with a patient record.

Tuesday, March 22 (14:00-16:00) Room: Odeum A/B

Workshop II: Workshop on Recent Advances in Video Capsule Endoscopy

Organizer:

Muzaffer Kanaan (Erciyes University, Turkey)

Hamed Farhadi (Visiting Scholar at Harvard University, USA)

Video capsule endoscopy (VCE) is an emerging imaging technique that enables medical professionals to monitor inside the body. Specifically, it facilitates monitoring of portions of the gastrointestinal (GI) tract, such as the small intestine, that is unreachable by conventional endoscopy techniques.

TUTORIALS, WORKSHOPS AND INDUSTRIAL PANELS

Current VCE systems are passive tools that are mainly used for diagnostic purposes only. The patient swallows a pill-sized capsule, containing a camera, which travels through the gastrointestinal tract by normal muscle movement. The camera captures images and the capsule transmits them wirelessly to an external receiver. Current VCE systems are FDA-approved for clinical use and have been used in clinical trials, however, there are some issues that need to be resolved in order to take full advantage of these systems. The first issue is the localization of endoscopy capsule inside the GI tract. This is a significant problem because if the images received from an endoscopy capsule convey the presence of an abnormal condition (such as a lesion or a tumor), the existing systems cannot localize the location of the abnormality within the GI tract. This makes subsequent surgical interventions considerably more difficult and time consuming. Localization of a passive endoscopy capsule within the GI tract is, therefore, a problem that needs to be addressed. In addition, the current VCE systems mostly use narrowband transmission techniques in the MICS band (402-405 MHz) and have very limited energy storage. Thus, they can only transmit images with a limited resolution. In order to facilitate image transmission at a higher resolution, power-efficient narrowband and possibly wideband transmission techniques (such as ultra-wide band) need to be investigated.

Recently, there has also been a lot of interest and R&D work devoted to developing active VCE systems (also known as robotic endoscopes) that can be maneuvered within the GI tract. The problem of capsule/robot localization is even more important in this case. In fact, since the location of the capsule is required to be known for providing appropriate feedback to the actuation system, the capsule needs to be localized much faster and with higher precision in this case. In addition, in some cases (such as magnetic actuation and localization), it is possible that the actuation and localization systems will interfere with each other, causing severe performance degradation.

This workshop within ISMICT-2016 solicits original papers on VCE systems including the following topics: Localization approaches for passive VCE, power-efficient transmission techniques for VCE, and wireless power transmission techniques for VCE.

TECHNICAL PROGRAM

Monday March 21

Technical Session 1:

BAN Technology: PHY and MAC Protocols

Monday, March 21 (10:30-12:30), Room: Odeum A/B

End-to-End Power Optimization in Non-homogenous Relay Environment for Wireless Body Area Networks (WBANs)

Dan Liu, (College of Information Engineering, Dalian Ocean University (DLOU), P.R. China), Yishuang Geng, and Kaveh Pahlavan, (Center of Wireless Information Network Studies (CWINS), Worcester Polytechnic Institute (WPI), USA)

Evaluation of Multiple Coexisting Body Area Networks Based on Realistic On-Body and Body-to-Body Channel Models

Mickael Maman, Francesco Mani, Benoit Denis, and Raffaele D'Errico, (CEA-LETI, Minatec Campus, France)

QoS-Aware Superframe Management Scheme Based on IEEE 802.15.6

Tomohiro Fukuya, and Ryuji Kohno, (Graduate School of Engineering Yokohama National University, Japan)

An Adaptive Error Control Scheme Considering Various Channel Conditions and QoS in Medical and Non-Medical Data for WBAN

Takahiro Goto, Kento Takabayashi, and Ryuji Kohno (Graduate School of Engineering Yokohama National University, Japan)

A Study on Optimizing Energy Detection for UWB-IR Receiver

Rintaro Ogiwara, Akira Nakamura, (Tokyo University of Science, Japan), Kohei Ohno, (Meiji University, Japan), and Makoto Itami, (Division of Advanced Communication Researches, RIST, TUS, Japan)

Technical Session 2:

Medicao BAN Applications and Services

Monday, March 21 (10:30-12:30), Room: Hagglund

A Virtual Vital Signs Sensor "MIRUWS" for Visualization of Healthy to Illness Transition (HIT)

Shigenobu Minami, Miki Haseyama, (Graduate School of Information Science and Technology Hokkaido University, Japan), Hirokazu Tanaka, (Information Sciences and Graduate School of Information Sciences, Hiroshima City University, Japan), Toru Takahashi, (NeutureNetworks Co., Japan), and Tatsuya Komori, (Toshiba Digital Media Engineering Co., Japan)

Human Motion Identification Using Functional Near-Infrared Spectroscopy and Smartwatch

Amir Mohammad Amiri, Mohammadreza Abtahi, (Department of Electrical, Computer, & Biomedical Engineering, University of Rhode Island, USA), Cara Nunez, and Kunal Mankodiya, (Department of Electrical, Computer, & Biomedical Engineering, University of Rhode Island, USA)

AirSniffer: A Smartphone-Based Sensor System for Body Area Climate and Air Quality Monitoring

Jeffrey P. Smith, and Xinrong Li, (Department of Electrical Engineering, University of North Texas, USA)

Evaluation of IR-UWB BAN for Certification based on Regulatory Science

Keiko Sameshima, and Ryuji Kohno, (Graduate School of Engineering, Yokohama National University, Japan)

Technical Session 3:

Antennas and Radio Propagation for Wireless BAN

Monday, March 21 (14:00-15:20), Room: Odeum A/B

Design and Development of a 3D Folded Slot Antenna for Body-Worn Wireless Devices

Trang Thai, James Sabatini, and S.M. Shajedul Hasan, (Electrical Technologies & Systems, GE Global Research, USA)

Human Tissue Type and Volume Effect on the On-Body UWB Antenna Matchings

Timo Kumpuniemi, Matti Hamalainen, Kamyar Yekeh Yazdandoost, and Jari Iinatti (Centre for Wireless Communications, University of Oulu, Finland)

Evaluation of Ground Loop Through the Floor in Human Body Communication

Ken Sasaki, Dairoku Muramatsu, Naruto Arai, (Graduate School of Frontier Sciences, The University of Tokyo, Japan), and Fukuro Koshiji, (General Education and Research Center, Tokyo Polytechnic University, Japan)

Bit-Error-Rate OTA Testing of BAN Antennas Based on Shadowing-Fading Hybrid Effects

Kun Li, Keisuke Murata, Kazuhiro Honda, and Koichi Ogawa, (Graduate School of Engineering, Toyama University, Japan)

TECHNICAL PROGRAM

Monday March 21

Tuesday March 22

**Technical Session 4:
Rehabilitation and Activity Monitoring**
Monday, March 21 (14:00-15:20), Room: Hagglund

Challenges in Wireless Networking for Real-Time Vital Sensing from Persons in Exercises

Shinsuke Hara, (Graduate School of Engineering, Osaka City University, Japan), Hiroyuki Yomo, (Graduate School of Engineering Science, Kansai University, Japan), and Takashi Kawabata, (Graduate School of Health and Well-being, Kansai University, Japan)

Towards Sedentary Lifestyle Prevention: An Autoregressive Model for Predicting Sedentary Behaviors

Qian He, and Emmanuel O. Agu, (Department of Computer Science, Worcester Polytechnic Institute, USA)

Experimental Study of an Optical Wireless Physical Activity Monitoring System

C.Le Bas, L.Chevalier, P.Toumieux, S. Sahuguede, and A. Julien-Vergonjanne, (University of Limoges/XLIM/Labex SigmaLim, France)

Elderly Person Monitoring in Day Care Center using Bluetooth Low Energy

Kiyoaki Komai, Manato Fujimoto, Yutaka Arakawa, Hirohiko Suwa, Yukitoshi Kashimoto, and Keiichi Yasumoto, (Graduate School of Information Science, Nara Institute of Science and Technology, Japan)

**Technical Session 5:
Wireless Capsule Endoscopy I**
Tuesday, March 22 (15:00-16:00), Room: Odeum A/B

In-Body Ranging for Ultra-Wide Band Wireless Capsule Endoscopy Using A Neural Network Architecture

Muzaffer Kanaan, and Memduh Suveren, (Erciyes University, Faculty of Engineering, Department of Mechatronics Engineering, Turkey)

An Adaptive Localization Technique for Wireless Capsule Endoscopy

Hamed Farhadi, (Chalmers University of Technology, Sweden), Javid Atai, (The University of Sydney, Australia), Mikael Skoglund, (KTH Royal Institute of Technology, Sweden), Esmail S. Nadimi, (University of Southern Denmark, Denmark), Kaveh Pahlavan, (Worcester Polytechnic Institute, USA), and Vahid Tarokh, (Harvard University, USA)

Using Magnetic Resonance Wireless Power Transfer to Operate a Scalpel on a Prototype of a Robotic Therapeutic Endoscope

Hidetoshi Ohta, (Department of Gastroenterology, Sapporo Orthopaedics and Cardiovascular Hospital, Japan)

**Technical Session 6:
Wireless Capsule Endoscopy II**
Tuesday, March 22 (16:30-17:50), Room: Odeum A/B

Adaptive Magnetic Sensing Based Wireless Capsule Localization

Ilknur Umay, and Baris, Fidan, (University of Waterloo, Canada)

An Energy Efficient Communication Technique for Medical Implants/Micro Robots

Nima N. Moghadam, (ACCESS Linnaeus Center, Royal Institute of Technology (KTH), Sweden), Hamed Farhadi, (Department of Signals and Systems, Chalmers University of Technology Gothenburg, Sweden), and Mats Bengtsson, (ACCESS Linnaeus Center, Royal Institute of Technology (KTH), Sweden)

OFDMA-based High Resolution Sensor Node ToA Estimation in Non-Homogenous Medium of Human Body

Mohsen Jamalabdollahi, and Seyed (Reza) Zekavat, (Department of Electrical and Computer Engineering Michigan Technological University, USA)

Performance Evaluation on WCE Localization Using GA-Based Three-Dimensional Electromagnetic Imaging

Taiki Iida, Daisuke Anzai, and Jianqing Wang, (Graduate School of Engineering, Nagoya Institute of Technology, Japan)

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TECHNICAL PROGRAM

Wednesday March 23

Technical Session 7: Medical Imaging and Patient Diagnostic Systems

Wednesday, March 23 (9:00-10:00),
Room: Odeum A/B

Technology for Multispectral Scanning, Detection and Imaging for Medical Diagnosis

Al Messano, and Mandeep Singh, (Integral ElectroMagnetronic Technologies LLC, (IEMT), USA)

Cardiac MRI Compressed Sensing Image Reconstruction with a Graphics Processing Unit

Majid Sabbagh, (Electrical and Computer Engineering Department, Northeastern University, USA), Martin Uecker, (Institute for Diagnostic and Interventional Radiology, University Medical Center Gottingen, Germany), Andrew J. Powell, (Department of Cardiology, Boston Children's Hospital, USA), Miriam Leeser, (Electrical and Computer Engineering Department, Northeastern University, USA), and Mehdi H. Moghari, (Department of Cardiology, Boston Children's Hospital, USA)

Smartphone-Based Biosensing Platform Evolution: Implementation of Electrochemical Analysis Capabilities

Francois Patou, Maria Dimaki, Winnie E. Svendsen, (Department of Micro and Nanotechnology, Technology University of Denmark, Denmark), Claus Kjægaard, (Department of Electrical Engineering, Technology University of Denmark, Denmark), and Jan Madsen, (Department of Applied Mathematics and Computer Science, Technology University of Denmark, Denmark)

Technical Session 8: Medical Signal Processing

Wednesday, March 23 (9:00-10:00), Room: Hagglund

On-line EEG Denoising Using Correlated Sparse Recovery

Manish Gupta, (Division of Sleep and Circadian Disorders, Departments of Medicine and Neurology, Brigham and Women's Hospital, USA), Scott A. Beckett, (Division of Sleep and Circadian Disorders, Departments of Medicine and Neurology, Brigham and Women's Hospital, USA), and Elizabeth B. Klerman, (Division of Sleep and Circadian Disorders, Departments of Medicine and Neurology, Brigham and Women's Hospital, USA)

A Robust ECG Steganography Method

S. Edward Jero, and Palaniappan Ramu, (Department of Engineering Design, Indian Institute of Technology Madras, India)

VO2 Estimation using 6-axis Motion Sensing Data

Masato Miyatake, Naoteru Nakamura, Takashi Nagata, Akira Yuuki, Hiroyuki Yomo (Graduate School of Engineering Science, Kansai University, Japan), Takashi Kawabata (Graduate School of Health and Well-being, Kansai University, Japan), and Shinsuke Hara (Graduate School of Engineering, Osaka City University, Japan)

Technical Session 9: Pervasive Health Care and Patient Monitoring

Wednesday, March 23 (10:30-11:30),
Room: Odeum A/B

Emotional Reactivity Monitoring Using Electrodermal Activity Analysis In Individuals With Suicidal Behaviors

Amir Mohammad Amiri, Mohammadreza Abtahi, Anna Rabasco, (University of Rhode Island, USA), Michael Armev, (University of Brown, USA), and Kunal Mankodiya, (University of Rhode Island, USA)

UWB Gesture Detection for Visually Impaired Remote Control

Yuzhang Zang, Kaveh Pahlavan, Yang Zheng, and Le Wang, (Center of Wireless Information Network Studies (CWINS) Worcester Polytechnic Institute (WPI), USA)

Evaluation of LoRa LPWAN Technology for Remote Health and Wellbeing Monitoring

Juha Petajajarvi, Konstantin Mikhaylov, Matti Hamalainen, and Jari Iinatti, (Centre for Wireless Communications, Department of Communications Engineering, University of Oulu, Finland)

Technical Session 10: Privacy and Security Issues

Wednesday, March 23 (11:30-12:30),
Room: Odeum A/B

Watermark-Based Secure Communications in Safety-Related Scenarios

Simone Soderi, (Centre for Wireless Communications, University of Oulu, Finland), Lorenzo Mucchi, (Department of Information Engineering, University of Florence, Italy), Matti Hamalainen, (Centre for Wireless Communications, University of Oulu, Finland), Alessandro Piva, (Department of Information Engineering, University of Florence, Italy), and Jari Iinatti, (Centre for Wireless Communications, University of Oulu, Finland)

Secure Access Delegation of Encrypted Medical Information

Arnab Deb Gupta, Yuriy Polyakov, and Kurt Rohloff, (College of Computing Sciences, New Jersey Institute of Technology, USA)

TECHNICAL PROGRAM

Wednesday March 23

Technical Session 11: Indoor Patient Localization

Wednesday, March 23 (10:30-12:30),
Room: Hagglund

Software Emulation of TOA Based Ranging with UWB Creeping Wave around Human Body

Xiaoxi Li, Fen Qin, Mingda Zhou, and Kaveh Pahlavan, (Center for
Wireless Information Network Studies, Worcester Polytechnic
Institute, USA)

On the Selection of Protocol and Parameters for UWB- based Wireless Indoors Localization

Konstantin Mikhaylov, Antti Tikanmaki, Juha Petajajarvi, Matti
Hamalainen, (Centre for Wireless Communications, Department
of Computer Science and Engineering, University of Oulu,
Finland), and Ruji Kohno, (Division of Physics, Electrical and
Computer Engineering, Yokohama National University, Japan)

Analyzing the Effect of Human Body and Metallic Objects for Indoor Geolocation

Fardad Askarzadeh, Kaveh Pahlavan, Sergey Makarov, (Center for
Wireless Information Network Studies, Worcester Polytechnic
Institute, USA), Yunxing Ye (BroadCom Limited Ltd.), and Umair
Khan, (Intel Corporation)

A Barometer-Assisted Method to Evaluate 3D Patient Geolocation inside Hospital

Julang Ying, (Center of Wireless Information Network Studies,
ECE Department, Worcester Polytechnic Institute, USA)
Chao Ren, (Azimuth Systems Inc.), and Kaveh Pahlavan, (Center
of Wireless Information Network Studies, ECE Department,
Worcester Polytechnic Institute, USA)

Using iBeacon for Newborns Localization in Hospitals

Zhouchi Li, Yang Yang, and Kaveh Pahlavan, Center for Wireless
Information Network Studies (CWINS), Worcester Polytechnic
Institute (WPI), USA

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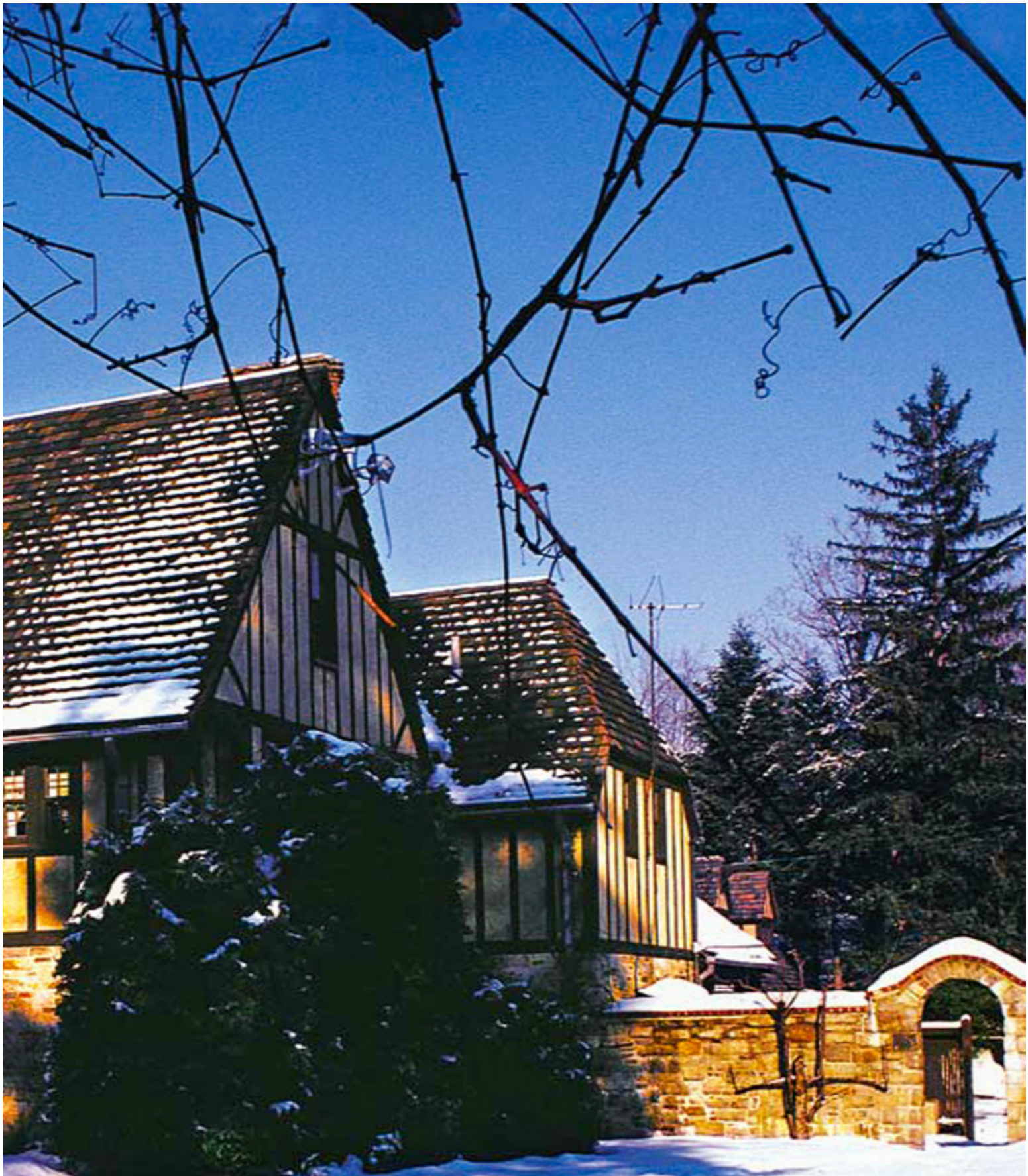
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