



521318S Modern Topics in Telecommunications and Radio Engineering:

Medical Healthcare and Its Advancement Based on Dependable ICT (Information and Communication Technology), 3 ECTS credits

Lecturer: Ryuji Kohno

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- Professor, Division of Physics, Electrical and Computer Engineering, Graduate School of Engineering, and Director, Center of Medical Information and Communication Technology, Yokohama National University, Japan
- CEO, University of Oulu Research Institute Japan – CWC-Nippon Oy(Co.), Japan

Course Description:

Healthcare and medicine must be very attractive fields for industry who is seeking a new huge market size of business while regional gap, high expense and sugary failure in medical health care becomes a serious social problem. Population ageing may crap social healthcare service due to exceeding expense for high cost and long treatment etc.

For these problems, advanced medical healthcare using sophisticated information and communication technology (ICT), so-called medical ICT can promote a new big business and improve medical healthcare services among hospitals, homes and peoples in country edges by networking. Ultimately advanced ICT will realize “Ubiquitous Medicine,” so that medical healthcare can be served for anyone anytime and anywhere.

This course of lectures will provide demand and trend of Ubiquitous Medicine, and introduce some advanced medical healthcare systems such as body area network (BAN), medical implant communication system (MICS) etc. The lecture will introduce technical requirements to carry out ubiquitous medicine based on such an advanced ICT that can satisfy the requirement to solve various problems. Standardization and regulation to make medical ICT social service and business successful are introduced international standard of wireless BAN IEEE802.15.6 can make a global market while various states of art in ICT have been developed and applied for.

Another important issue must be regulation for medical device because it takes a long time and cost much for regulatory compliance test for human life safety. The lecture also introduces “regulatory science,” which is important to analyze risk and benefit of new invented medical devices, to make a regulation acceptable for anyone and to educate experts for regulatory compliance testing.

Moreover, BAN can be applied for a body of robotics, car, building, bridge etc. for remote maintenance as well as a human body for remote health care. This means that BAN could be a core in internet of things (IoT) and M2M in a sense of machine centric communications rather than human centric communications so than BAN of things can guarantee highly reliable, secure, resilient, or dependable performance against disaster and natural hazard as well as medical BAN against diseases.

In car industry, particularly, autonomous driving with auto braking and factory automation with remote diagnose are keen for Industry 4.0. This lecture addresses activities of international standardization, e.g. IEEE802.15 IG-DEP (Interest Group of

Dependability) which the lecturer has been chairing. Policy for dependable networks with definition of dependability in networks are described. Focused use cases or applications, mandatory technical requirement, evaluation criteria for draft standard proposals will be introduced and discussed in order to contribute in making international standard.

In the lecturers, business model of these dependable medicine and BAN of things for global market with regulatory compliance will be introduced in EU, Japan and the rest of world.

Structure: The course will consist of **two parts**.

Part I will include several hours of lectures spread over four days.

Part II will consist of presentations by registered students discussing possible research themes of learnt requirement, technologies, and applications using advanced wireless technologies for advanced medical healthcare. Each student will make a presentation on research themes and scenario and prepares a report on that (**Part III**). These discussions and reports are evaluated instead of exams.

Keywords: Ubiquitous Medicine, EMC, Array Sensor, Space-Time Signal Processing, Software Reconfiguration, Cognitive Systems, Ultra Wideband, Sensor Networks, Medical ICT, Body Area Network (BAN), Medical Implant System (MICS), Regulatory Science, Compliance Test, IEEE802, MIC, PMDA, FCC, FDA, IoT, M2M, 5G, BAN of Things, Disaster Prevention, Dependability

Timetable: Part I: Lectures and Lecture rooms

Friday 25.08.2017 09:15-12:00 (3 lecture hours), TS127

Monday 28.08.2017 09:15-12:00 (3 lecture hours), TS127

Tuesday 29.08.2017 13:15-16:00 (3 lecture hours), TS128

Thursday 31.08.2017 09:15-12:00 (3 lecture hours), TS127

Part II: Student presentations

Friday 01.09.2017 09:15-12:00 (3 lecture hours), M101

Part III: Report Submission:

Report should be submitted to kohno-ryuji-ns@ynu.ac.jp no later than September 30 (Saturday)

Course Contents:

1. Overview of Advanced Medical Healthcare Based on ICT
2. Background and Demand
3. Global Trend and Projects on Medical ICT
 - 3.1 Ubiquitous Medicine Based on Advanced ICT
 - 3.2 Related Projects
4. Required Wireless Technologies
 - 4.1 Basic Communication Theory and Advanced ICT
 - 4.2 Adaptive Array Antenna and Sensor
 - 4.3 Space-Time Signal Processing and Communication Theory
 - 4.4 Software Defined (Reconfigurable) Radio and Network
 - 4.5 Cognitive Radio and Network
 - 4.6 Spread Spectrum and Ultra Wideband (UWB) Communications and Ranging
5. Medical ICT (Information and Communication Technology)
 - 5.1 Overview of Medical ICT
 - 5.2 Body Area Network (BAN) and Design, Medical Implant Communication System (MICS)
 - 5.3 BAN Research and Development
 - 5.4 BAN Applications

- 5.5 BAN Standard (IEEE802.15.6)
- 5.6 BAN Channel Measurement and Modeling
- 5.7 BAN Technologies in PHY and MAC Layers
- 5.8 Dependable Medical Healthcare Platform with BAN
- 6. Regulatory Science and Business Model for Medical ICT
 - 6.1 Regulations for Radio and Medicine (FCC, FDA, MIC)
 - 6.2 Clinical Testing for Medical Regulation and Type Approval for Radio Regulation
 - 6.3 Regulatory Science for Medical Devices and Services
 - 6.4 Class 0.5 and MIBYO Healthcare Devices
- 7. BAN of Things and Dependable IoT & M2M
 - 7.1 Dependable IoT and M2M for Medicine, Cars, Energy, Disaster etc
 - 7.2 Standardization of Dependable Wireless Networks (IEEE802.15 IG-DEP)
 - 7.3 Major Applications of Dependable Wireless Networks
 - 7.4 Technical Requirement of Dependable Wireless Networks
 - 7.5 Interdisciplinary Communication and Controlling Theories
 - 7.6 Multi-layer Technologies for Enhanced Dependability
 - 7.7 Business Model of Medicine, Cars, Energy, Disaster etc.
- 8. Concluding Remark

Biography:

Ryuji Kohno received the Ph.D. degree from the University of Tokyo in 1984. Since 1998 he has been a Professor of the Division of Physics, Electrical and Computer Engineering, and the Director of Center on Medical Information and Communication Technology, in Yokohama National University in Japan. In his currier, he was a director of Advanced Telecommunications Laboratory of SONY CSL during 1998-2002, a director of UWB Technology institute of National Institute of Information and Communications Technology (NICT) during 2002-2006, and that of Medical ICT institute of NICT during 2006-2012. Since 2012 he is CEO of University of Oulu Research Institute Japan – CWC-Nippon Co.

In his academic activities, he was elected as a member of the Board of Governors of IEEE Information Theory (IT) Society in 2000, 2003 and 2006. He has played a role of an editor of the IEEE Transactions on IT, Communications, and Intelligent Transport Systems (ITS). He is fellows of IEEE and IEICE, and was vice-president of Engineering Sciences Society of IEICE, the Chairmen of the IEICE Technical Committee on Spread Spectrum Technology, ITS, and Software Defined Radio(SDR), Medical ICT, and Reliable Robust Controlling Communications. Prof. Kohno has contributed for organizing many international conferences, such as a chair-in honor of International Conferences of SDR (SDR02 & SDR03), a general co-chair of IEEE International Symposium on IT (ISIT03), UWBST&IWUWB04, IWUWBST05, International Symposia Medial ICT (ISMICT2006, 2007, 2010, 2012 & 2014), Joint International Symposia on Information Theory and Its Applications (ISITA2010) and on Spread Spectrum Technology and Applications (ISSSTA2010). He was awarded IEICE Greatest Contribution Award and NTT DoCoMo Mobile Science Award in 1999 and 2002, respectively. He is IEEE and IEICE fellows

Since 2007, he became a Finnish Distinguished Professor (FiDiPro). He was a principal leader of MEXT Global COE (Centre of Excellence) program on “Innovative Integration between Medicine and Engineering Based on ICT,” during 2008-2013 and JSPS-TEKES joint program on Life Science during 2013-2015 to promote joint research and education between Finland and Japan. Since 2014, he is a director of Medical Device Regulatory Science Center in YNU.