

# IEICE General Conference 2021 Group

## A: Engineering Sciences Society [Click here to see details.](#)

A-1. Circuits and Systems / A-2. Information Theory / A-3. Reliability / A-4. Ultrasonics / A-5. Engineering Acoustics / A-6. VLSI Design Technologies / A-7. Information Security / A-8. Signal Processing / A-9. Wide Band Systems / A-10. Mathematical Systems Science and its Applications / A-11. Thought and Language / A-12. Technology, Society, and Ethics / A-13. ITS / A-14. Smart Info-media System / A-15. Image Media Quality / A-16. Reliable Communication and Control / A-17. Biometrics / A-18. Information and Communication Technologies for Safe and Secure Life/A-19. Hardware Security / H-1. Human communication science / H-2. Human information processing / H-3. Media Experience and Virtual Environment / H-4. Welfare Information Technology / N-1. Nonlinear Problems / N-2. Complex Communication Sciences

## N: NOLTA Society [Click here to see details.](#)

N-1. Nonlinear Problems / N-2. Complex Communication Sciences

## B: Communications Society [Click here to see details.](#)

B-1A. Antennas and Propagation A (Electromagnetic Wave Propagation and Applications Except for Communications) / B-1B. Antennas and Propagation B (Antennas - general) / B-1C. Antennas and Propagation C (Antenna Systems) / B-2. Space, Aeronautical and Navigational Electronics / B-3. Satellite Communications / B-4. Electromagnetic Compatibility / B-5A. Radio Communication system A (mobile communication) / B-5B. Radio Communication system B (Wireless access networks) / B-6. Network Systems / B-7. Information networks / B-8. Communication System / B-9. Energy Engineering in Electronics and Communications / B-10A. Optical Communication Systems A (Optical Fibers) / B-10B. Optical Communication Systems B (Optical Communication System, Optical Communication Equipment, Device Application to Systems, Optical Communications Network / Specification) / B-11. Communications Quality / B-12. Photonic Network / B-13. Optical Fiber Technologies / B-14. Technical Committee on Information Communication Management / B-15. Sensor Networks and Mobile Intelligence / B-16. Internet Architecture / B-17. Smart Radio / B-18. Short Range Wireless Communications / B-19. Healthcare and Medical Information Communication Technology / B-20. Wireless Power Transfer

## C: Electronics Society [Click here to see details.](#)

C-1. Electromagnetic Theory / C-2A. Microwave and Millimeter Wave Active Devices and Circuits / C-2B. Microwave and Millimeter Wave Passive Devices / C-2C. Microwave and Millimeter Wave Systems and Subsystems / C-3/4. Optoelectronics / Lasers and Quantum Electronics / C-5. Electromechanical Devices / C-6. Electronic Component Parts and Materials / C-7. Magnetic Recording / C-8. Superconducting Electronics / C-9. Electronic Displays / C-10. Electron Devices / C-11. Silicon Device and Materials / C-12. Integrated Circuit and Devices / C-13. Organic Molecular Electronics / C-14. Technical Committee on Microwave Photonics / C-15. Electronics Simulation Technology

## D: Information and Systems Society [Click here to see details.](#)

D-1. Theory of Computation / D-2. Neuro Computing / D-3. Software Science / D-4. Data Engineering / D-5. Natural Language Understanding and Models of Communication / D-6A. Computer Systems A (Architecture) / D-6B. Computer Systems B (Hardware) / D-6C. Computer Systems C (Software) / D-7A. Medical Engineering and Biocybernetics A (Biocybernetics) / D-7B. Medical Engineering and Biocybernetics B (Medical Engineering) / D-8. Artificial Intelligence and Knowledge Engineering / D-9. Life Intelligence and Office Information System / D-10. Dependable Computing / D-11A. Image Engineering / D-11B. Image Engineering / D-12A. pattern recognition and media understanding A(recognition, understanding, and synthesis of pattern media) / D-12B. pattern recognition and media understanding A(recognition, understanding, and synthesis of pattern media) / D-13. Knowledge Based Software Engineering / D-14. Speech and auditory processing / D-15. Educational Technology / D-16. Medical Imaging / D-17. Software Interprise Modeling / D-18. Reconfigurable Systems / D-19. Information and Communication System Security / D-20. Information Based Induction Sciences and Machine Learning / D-21. Enriched Multimedia / D-22. Cloud Network Robotics / D-23. Services Computing

## A: Engineering Sciences Society

### A-1. Circuits and Systems

Circuit Theory (Linear and Non-linear, Passive and Active, Time-variant and Time-invariant, lumped constant and distributed constant), Modeling and Simulation, Computer Aided Design for Circuits, Filters, Analog and Digital Circuits, Analog-Digital Converters, Digital-Analog Converters, Application of Electronic Circuits, Signal Theory and Signal Processing Algorithms, Analog and Digital Signal Processing Circuits, VLSI Systems, Neural Networks, Combinatorial Algorithms, Graph and Networks, System and Control, Operations Research, Large Scale Systems, Circuits and Systems for Power Electronic

### A-2. Information Theory

Shannon theory, fundamental mathematics for information theory, source coding, data compression, image coding, speech coding, channel coding, storage coding, error-correcting code and error-detecting code, coded modulation, multi-user information theory, stochastic processes, hypothesis testing and parameter estimation, large deviation theory, control theory, combinatorics, cryptography, information security, signal theory, signal detection, signal processing, communication systems, intelligent information processing and inference engine, quantum information theory, optical communication theory, applications of information theory, genetic codes.

### A-3. Reliability

Theory of Reliability and Maintainability, High Reliability Design, Reliability Test, Reliability Growth and Prediction Model, Anomaly Prediction and Diagnostics, Failure Analysis, Software Reliability, Human Reliability, Maintenance Plan and Support, Data Collection and Processing, Reliability and Maintainability Management

### A-4. Ultrasonics

ultrasonic transducer, bulk waves, surface acoustic waves, elastic vibration, vibration measurements, medical ultrasonics, biological effects by ultrasound, acoustic microscope, ultrasonic sensor, vibratory gyroscope, high-power ultrasound, underwater acoustics, physical acoustics, sonochemistry, piezoelectric device, ultrasonic spectroscopy, piezoelectric materials, ultrasonic sensing, nondestructive inspection, nonlinear acoustics, ultrasonic actuator, acousto-optic interaction

### A-5. Engineering Acoustics

Systems, components, devices and materials related to audio signal, acoustic wave and machinery vibration. Sound reception, reproduction, signal transmission, coding, and recording. Electro-acoustic transducer and telephone. Sound field control system, active noise control system and other acoustic signal processing systems. Human-machine interface. Sound field and acoustic environment. Musical acoustics and instruments. Audio signal analysis and processing. Acoustic measurement and instrumentation. Theories of acoustics and newly applied technologies.

### A-6. VLSI Design Technologies

Design Methodologies, Computer Aided Design (CAD) for Function, Logic, Circuit, Layout, Test and Diagnosis, Simulation (Functional, Logic, Circuit, Modeling, Process, Device), Timing Verification, High-level Synthesis, Logic Synthesis, Hardware Description Languages, Design Database, VLSI Architecture, Hardware/Software Co-design, Low-power Design, Analog Circuit and Layout Synthesis, CAD Hardware, CAD Framework, VLSI Design Environment, Technology Migration (Logic Conversion, pattern/Rule Conversion), Design Verification, Design for Manufacturability, 3D LSI Design, PCB and Package Design, Lithography CAD

### A-7. Information Security

Cryptographic theory, Information theoretic security, Symmetric encryption, Hash function, Random numbers, Application of number theory, Asymmetric encryption, (Hyper-)Elliptic curve cryptography, Pairing, ID-based encryption, Homomorphic encryption, Signatures, Authentication, Key management, (Post-)Quantum cryptography, Cryptographic implementation, Side channel attacks, PUF, Cryptographic protocols, Card-based cryptography, Formal method, Machine learning security, Network security, Malwares, Web security, Ubiquitous security, IoT security, Cloud security, Control system security, Vehicle security, Mobile security, Embedded system security, Secure OS, Watermarking, Content protection, Software protection, Cryptographic currency, Fintech, Privacy protection, Anonymity, Biometric, Protection of biometric template, Education and psychology, Security model and evaluation.

## A-8. Signal Processing

Theory and Methods for Signal Processing, Digital Filters, Filter Banks, Implementations of Signal Processing Systems, VLSI Signal Processing, Parallel Signal Processing, Signal Processors, Linear Prediction Theory, Information Compression, Error Correcting Code, Estimation Theory, Adaptive Signal Processing, Signal Processing for Communications, Image and Video Processing, Multidimensional Signal Processing, Speech and Audio Signal Processing, Nonlinear Signal Processing, Neural Network Signal Processing, Intelligent Signal Processing, Biomedical Signal Processing, Signal Processing Applications.

## A-9. Wide Band Systems

Spread spectrum(SS), Orthogonal frequency division multiplexing(OFDM), Ultra wide band (UWB), Theory of code sequence design ( construction method of spreading code, error correcting code, etc.), Wide band system design/evaluation theory (system design for any applications, comparison and evaluation to other systems, etc.), Modulation & demodulation techniques and theories ( modulation & demodulation methods, circuits, devices, multi-carrier transmission, time-space signal processing, etc.), Synchronization systems/ devices( carrier synchronization, code acquisition & tracking, synchronization circuits, synchronization methods, synchronization devices, etc.),Multiple access techniques (CDMA, SDMA(space division multiple access), TDMA, FDMA, and hybrid techniques, etc.), Radio propagation and antennas related with WBS ( propagation, analysis of transmission characteristics, antenna techniques, input-output interface techniques. etc.), Application areas ( public communication, personal communication, wireless LAN, power line transmission, consumer communication, multi media communication, ITS (intelligent transport systems), distance measurement, software radio, optical CDMA, optical space processing, quantum communication, chaos communication, digital broadcasting, wireless communication, wired communication, xDSL, and UWB based on wide band techniques), and other boundary areas to apply the same principle and phenomenon.

## A-10. Mathematical Systems Science and its Applications

Basic theory on mathematical systems science (graphs,Petri nets, networks, concurrent systems, systemoptimization, multi-agent systems, hybrid systems,distributed systems, game theory, discrete eventsystems), mathematics on system design and verification(formal modeling, formal verification, diagnosis,performance evaluation, simulation, fault tolerance),mathematics on cyber-physical systems (embedded systems,networked control, sensor networks, cooperative control,real-time systems), mathematics on human factors(modeling and analysis on human activity, businessprocess, service science), applications (workflow,elevator control, manufacturing scheduling, AGV control,on-demand bus control, design of large-scale software),new approaches (open system science, systems biology), artificial intelligence(machine learning, discrete and continuous optimization theory) other approaches on theory and application ofmathematical systems science.

## A-11. Thought and Language

Observation / analysis / formulation and modeling of mental processes and brain functions of thought and language, Mental processes related to acquisition and operation of languages, Observation / analysis / formulation / modeling of brain functions, Production and understanding paralinguistic information and its role, Theory and support technology base on smooth communication (universal design, advanced network, contents creation etc.), Knowledge processing and computer-aided systems (intellectual CAD, intelligent information retrieval and processing, decision making etc.), Education systems (CAI, composition support, etc.), Multiple intelligence theory, Art thinking, Design thinking, Learner (speech) corpus, DDL (Data-Driven Learning), 4 skills test, Language landscape, Hospitality communication, Language and culture, Language relativity hypothesis, Communication based on location information

## A-12. Technology, Society, and Ethics

Information communication and ethics, Information oriented society and metamorphosis of the human, Privacy and protection of the personal information, Information security and ethics, Intellectual property, Ethics, Ethics for medical information, Digital divide

## A-13. ITS

general research on social activities with ITS, general research on ITS related services, ITS communication technology (road-to-vehicle communication, inter-vehicle communication, ETC, beacon, mm-wave communication, network architecture and so on), ITS electronics technology (car navigation system, IC card, automatic driving system, automatic vehicle guide system and so on), ITS ergonomics technology (car human interface (CHI), car multimedia information presentation, pedestrian related

ITS technology and so on), ITS infrastructure technology (traffic management, traffic surveillance, vehicle guidance, emergency car support and so on), ITS technologies for aviation, maritime and land transportation (aviation, maritime and rail related ITS technologies and so on), ITS sensing technology (positioning, ranging, image sensing, traffic detection & surveillance, obstacle detection & surveillance and so on), ITS vision technology (image recognition, traffic flow measurement, incident detection & surveillance and so on), ITS information technology (geographic information system(GIS), travel information, architecture information, automatic vehicle control, vehicle control learning, electronic payment and so on), any other researches related to ITS

#### **A-14. Smart Info-media System**

Smart mobile system(smart personal system, personal information system, smart home electronics, personal human interface), Soft computing(neuro-fuzzy system, evolutionary system, adaptive system to environment, human adaptive system), Intelligent multimedia processing system(adaptive media processing, nonlinear media processing, media recognition system, kansei information processing), System on silicon(ultrahigh-speed media system, micro information processing system, media system with highly low-power consumption, ubiquitous system), Near field radio communication application system including RFID (hardware, system, application)

#### **A-15. Image Media Quality**

[Fundamentals for image quality assessment]

Generalized image evaluation models for imaging media, Psycho-physical model, Measure theory for image quality assessment, Measurement theory for image quality assessment, Subjective evaluation method, Image information characteristic analysis, Observation environment and visual characteristic [Medium-oriented image evaluation assessment theories]

Capture medium, Communication medium, Broadcasting medium, Storage medium, Error evaluation for image coding theories, Display medium, Printing medium, Computer Graphics, Virtual reality, Mixed Reality

[System for image quality evaluation]

Evaluation software, Evaluation hardware, Evaluation system

#### **A-16. Reliable Communication and Control**

Reliable remote control/wireless control, Networked control, M2M (Machine-to-Machine), IoT (Internet of Things), Distributed control for multi-agent systems, Control system design for large-scale/hybrid/stochastic/time-delay systems, Fundamental theory for reliable remote control (information theory, modulation and demodulation theory, coding theory, network theory, signal processing, algorithm, artificial intelligence, machine learning, etc.), Applications (manufacturing line/plant, energy network, medical welfare, transportation systems, architectural construction, urban design, disaster preparedness, crime prevention, defense, etc.), Research, development, rule making, industrialization, and realization on topics in the above multi- and interdisciplinary areas.

#### **A-17. Biometrics**

Biometrics and Related Topics (Device, Sensor, Algorithm, Media Processing, Pattern Recognition, Security, Biological Information Measurement, Software/Hardware Implementation, Accuracy Evaluation, Performance Evaluation, Database, Network, System Architecture/Operation, Service, Privacy, Social Implementation, etc.)

#### **A-18. Information and Communication Technologies for Safe and Secure Life**

Information and Communication Technologies for Safe and Secure Life (Ad-hoc networks construction technologies, Congestion control technologies, Reliable wireless access technologies, Delay tolerant network technologies, Broadband radio transmission technologies, Network system design technologies, Facility location design technologies, ITS (intelligent transport systems) technologies, sensor network technologies, GIS (Geographical information systems) technologies, etc.),

Researches in social science for Safe and Secure Life (Disaster informatics, Behavioral disaster management, Disaster resilience, Service sciences etc.), Maintenance, management and operation technologies in the social infrastructure (Communication networks, Electric power networks, Highway road networks, railroad networks, etc.)

#### **A-19. Hardware Security**

All topics related to security and hardware, Cryptographic hardware, Tamper resistance, Authenticity of devices, Hardware Trojan, Malicious hardware, Implementation of cryptographic algorithm, security algorithm, Instrumentation security, Automotive security, Vehicular security, Embedded security, PUF, TRNG, Artifact-metrics, Biometrics, Security hardware architecture, Security hardware performance, Cyber-physical system, IoT system, Physical attack, Implementation attack, Side-channel attack, Fault injection attack

## H-1. Human communication science

Communication theory, Media theory, Information-based semantics theory, Advanced information theory, Human model, Human error, Interaction model, Creativity and thinking support environment, Collaborative work support environment, Communication support for disabled/aged people, Nonverbal communication), Psychology · Behavioral science · Social psychology · Organizational theory

## H-2. Human information processing

Human interface technology, Man-machine interaction, Multi-modal interface/information processing, Kansei/affective information processing, Emotion expression and recognition, Measurement and analysis of human factors, Human information processing, Visual and auditory information processing, Analysis and modeling of human vision system, Perception and cognition in real/virtual environment, Bio-signal processing technology and analysis, Bio-behavior understanding and synthesis

## H-3. Media Experience and Virtual Environment

intelligent communication technology(intelligent coding, knowledge-based communication, communication for understanding meaning/intention), artificial reality technology (artificial reality, virtual environment, cyber interface, media arts), presence communication (3D communication, wide view communication, five-sense communication, spatial operation) media processing (multimedia understanding /transformation /archive /process/synthesis, integrated multimedia coding, multimedia interface, hypermedia, mobile multimedia, agent), Cooking Media (ubiquitous cooking support, analysis of cooking video, cooking archiving and food log, recipe recommendation, recipe text processing, food communication).

## H-4. Welfare Information Technology

Support for Persons with Visual Disabilities (Braille Translation System, Speech Synthesis, Screen Reader, Character Recognition, Image Recognition, Screen Magnifier, CCTV, Refreshable Braille Display, Tactile Graphic Display, White Canes, Orientation and Mobility Training, Mobility Aids), Support for Hearing impaired people (Sign Language Recognition, Sign Language Synthesis, Speech Recognition, Automatic Summarization, Speech Training, (Closed) Captioning, Subtitle, Remote Communication System / Tele-communication System, Hearing Aids), Support for Deaf-Blind Persons (Finger Braille, Braille Translation, Refreshable Braille Display, Tactile Graphic Display) , Support for Persons with Physical Disabilities (Powered Wheelchairs, AAC (Augmentative and Alternative Communication) Devices, VOCA (Voice Output Communication Aid), Control Devices, Interface Devices), Support for Persons with Intellectual Disabilities (Learning Aids, Educational Aids, Cognitive Skill Training, Cognitive Aids) , Support for Elderly Persons (Sensory Characteristics of Elderly Persons, Interface Devices for Elderly Persons, Hearing Aids, Monitoring System), Information Access (Dictation System, Automatic Braille Printing System, Web Accessibility), IT-Based Assistive Devices (Device Designing, Informatics Evaluation of Assistive Technologies, Universal Design, Manipulator, Lifting and Positioning Robot, Assistive Robot), Basics of IT-Based Assistive Technologies(Fundamental Considerations in Applying Informatics as Assistive Technologies), IT-Based Assistive Technologies in General: Activities of Daily Living, Support for Improving QOL, Sensory Substitution, Communication, Evaluating Methods, Ethics in Research.

## **N: NOLTA Society**

### **N-1. Nonlinear Problems**

Nonlinear Problems in Electric Circuits, Electromagnetism, Machines, Control, and other Systems, Chaos, Fractal, Soliton, Theory and Applications of Neural Networks, Nonlinear Phenomena in Large Scale Electric and Electronic Circuits and their Numerical Analysis, Nonlinear Phenomena in Interdisciplinary Areas, Applied Mathematics related to Nonlinear Phenomena, Nonlinear Problems in Biology, Psychology, Economics, and Social Phenomena (including Cybernetics, Models of Neuronal Circuits, Reaction-Diffusion Systems, and Pattern Formation)

### **N-2. Complex Communication Sciences**

Communications and network applications with nonlinear sciences, complex sciences, and graph theory, and network theory, Sciences of bio-systems, communication systems, wireless communications, information networks, mobile networks, radar and tomography measurements, and power networks, Nonlinear sciences, complex sciences, and bio-system sciences using network-research-field theories, Sciences and applications of distributed optimization, Physical random number generators and security,

## **B: Communications Society**

### **B-1A. Antennas and Propagation A (Electromagnetic Wave Propagation and Applications Except for Communications)**

Radio and optical wave propagations, Diffractions and scatterings, Mobile propagations, Indoor propagations, Propagations in troposphere and ionosphere, wireless power transmission, Radio telemetry and remote sensing, Measurement of electromagnetic compatibility.

### **B-1B. Antennas and Propagation B (Antennas - general)**

Antenna theories, Antenna elements, Array antennas, Aperture antennas, Millimeter-wave antennas, Small antennas, Design and analysis methods of antennas, Human body effect.

### **B-1C. Antennas and Propagation C (Antenna Systems)**

Antenna measurements, Feeding circuits, Adaptive antennas, MIMO antenna systems, DOA estimation, Radio- and optical-fused techniques.

## **B-2. Space, Aeronautical and Navigational Electronics**

[Satellite technology]

Satellite system, satellite subsystem and component, development and exploitation of satellite mission equipment, small satellite, space station, on-orbit service, attitude and orbit control

[Electronic and radio-wave application system]

Radar, ranging and positioning, time standard, micro-wave and optical communication, data relay, tracking, telemetry command, energy transmission

[Remote sensing]

Earth and scientific observation system, technique related with disaster prevention, sensor, equipment for data processing, recording, and transmission

[Navigation and traffic control]

Satellite positioning, GNSS, GPS, QZSS, pseudolite, air and road traffic control, location-based services

## **B-3. Satellite Communications**

[Satellite communications and broadcasting systems]

Fixed satellite communication systems, Mobile/Maritime/Aeronautical satellite communication systems, Broadcasting satellite systems, Inter-satellite communication systems, Geostationary orbit systems, Non-geostationary orbit systems, Frequency sharing technologies, Interference mitigation techniques

[Hardware for satellites and earth stations]

On-board equipment, Earth station equipment, Mobile terminals

[Satellite application systems]

Satellite-ground integrated communication system, Satellite-ground complementary systems, Remote learning and remote medicine, Disaster countermeasures and preventions, Digital divide provisions, Satellite internet, Satellite sensor networks, System cost analysis, UAS and ocean relay communication link

[Elementary technologies for communications]

Modulation and demodulation technologies, Coding technologies, Optical communication technologies, Access methods, Error correction methods, Security technologies, Communication protocols, Satellite based positioning

[Control and management methods]

Network control and management methods, Resource control and management methods, Satellite orbit and attitude control

## **B-4. Electromagnetic Compatibility**

[EMC Countermeasures and EMC design techniques]

Transmission line, EMC design of electronic circuit, PCB (Printed circuit board), Circuit analysis and design, Near/Far field analysis, Probes, Electromagnetic coupling, Matching circuit

[EMC measurement techniques and International standards]

Emission, Immunity, Antenna factor, Standard, EMC assessment, International standard, Standardization, Spectrum Utilization

[EMC materials and biological effect of EM fields]

EM absorber, Shielding and gasketing, Filters, Sensors, Material constants, EMC applications of metamaterial, SAR, Medical applications

[EMC problems in communication systems]

PLC (Power line communications), Wireless LAN, PDA (Personal Digital Assistants), Signal integrity, Communication Error, Cables, Connectors, Broadband EMI  
[Discharge noise and others]  
ESD (Electrostatic discharge), Electrical contacts, Surge, Transients, Lightning, Man-made noise, Natural noise, Estimation of source location

## **B-5A. Radio Communication system A (mobile communication)**

Wireless communication theory, Wireless transmission technology, Wireless access technology, Wireless networking technology, Wireless communications standardization/implementation technology.

## **B-5B. Radio Communication system B (Wireless access networks)**

Wireless communication theory, Wireless transmission technology, Wireless access technology, Wireless networking technology, Wireless communications standardization/implementation technology.

## **B-6. Network Systems**

[Network Architecture]

Ubiquitous Network, Mobile Network, Ad hoc/Sensor Network, Overlay/P2P Network, Programmable Network, NGN/New Generation Network, SDN/NFV, IoT

[Network System Technology]

Server and Client Architecture, System Software/Hardware, Switching System, Transport System, System Reliability Technology, System Virtualization, Cloud System Architecture, Edge Computing

[Network Control and Protocols]

Routing, Multicast, Application Level Control, Session and VoIP control, Flow and Queuing Control, Cross Layer Control, Wired and Wireless LAN Protocol, Traffic Engineering, TCP/IP

[Network Application Enablers]

Content Delivery/Distribution/Streaming, VoIP, Web Service, Network Software, Security, AAA (Authentication, Authorization and Accounting), Privacy, Blockchain

[Network Quality and Management]

Traffic Theory, Traffic and Quality Evaluation, Network Performance Evaluation, QoS/QoE, Resiliency/Reliability/Robustness, Traffic and Quality Management, Network Intelligence/AI, Network and Systems Management

## **B-7. Information Networks**

Overlay Network/P2P, IPv6, Next Generation Network (NGN)/New Generation Network (NWGN)/Future Network, Ad-hoc Sensor Network (MANET), Home Area Network (HAN), Cloud/Data-Center Network, CCN/NDN/ICN, Smart Grid

[Information Network Service and Applications]

Contents Delivery/Contents Exchange, Web Service/SOA/ROA Platform, Social Networking Service (SNS), Authentication/Identity Management, Green/Energy Saving ICT, In-Vehicle/Vehicle-to-Vehicle/Road-to-Vehicle Communication/ITS, High Performance Computing (HPC), Big-data Analysis/Cyber Physical System (CPS)

[Network QoS, Traffic Theory, Performance Analysis]

Routing and Switching, Performance Analysis and Simulation, Network Science, Self-organized/Distributed Control, Quality of Service (QoS)/Quality of Experience (QoE) Control, TCP/IP / BGP / DNS, Traffic Engineering, HTTP/2

[Network Control, Operation and Management]

Congestion Control, SDN (OpenFlow etc.)/NFV, Traffic/Flow Control, Session Management (SIP/IMS), M2M/IoT Communication Management, Disaster Response/Contingency Plan/BCP/Resilience, Application of Machine Learning and Information Theory on Networks, Nature Inspired Networks

[Implementation and Security Issues in Networked Systems]

Network Reliability, Interoperability/Standardization, Security and Privacy, Wireless LAN (Wi-Fi), Cyber Attack Countermeasures

## **B-8. Communication System**

[Network control]

Broadband access, Multiplexing/Synchronization, Routing/Traffic control, Resilience control, and Co-operation between optical and wireless

[Transport]

Power line communication, Optical transport, Wireless transport, Under water communication, and Wireless power transfer

[Modulation, coding and signal processing]

Modulation/demodulation, Error detection/correction coding, Signal coding, Digital signal processing, Digital signal processor, and Network coding

[Network architecture and implementation]

Access network, Wide area Ethernet, Home network, Network security, SDN (Software Defined Network), IoT/M2M, Ad hoc network, Cognitive wireless

[Network applications]

Broadband services, Video delivery services, Control network applications, Medical applications, Educational applications, Energy applications, Transport applications

## **B-9. Energy Engineering in Electronics and Communications**

[Power devices]

Semiconductor devices, Magnetic devices, Piezoelectric devices, Micro-electronic application

[Power conversion equipment]

DC-DC converter, Rectifier, Inverter, Active filter, Soft switching, New circuit for power converter and control

[Power system]

Power supply system, Uninterruptible power supply system, Compactness, High-density and Integration, Packaging, cooling technology, Measurement Analysis and Simulation, Reliability, Electromagnetic compatibility, New industrial and home appliances for power

[Energy system]

Photovoltaic power generation, Fuel-cell power generation, Wind-power generation, Energy transmission and supply system, Energy saving system, Superconducting technology, Heat utilization technology, Hydrogen energy technology

[Battery]

High-energy density, Long-life and High reliability, Maintenance and management technology

## **B-10A. Optical Communication Systems A (Optical Fibers)**

[Optical Fibers]

Telecom Optical Fibers, Optical Fiber Cords/Cables, Specialty Optical Fibers, Space Division Multiplexing (SDM) Optical Fibers, Optical Connecting techniques/Optical, Connectors/Wiring techniques, Optical Interconnection, Optical Fiber Operation, Administration, and Maintenance (OAM), Optical Fiber Measurement techniques

## **B-10B. Optical Communication Systems B (Optical Communication System, Optical Communication Equipment, Device Application to Systems, Optical Communications Network/Specification)**

[Optical Communication System]

Optical Modulation/Demodulation, Optical Digital Signal Processing Algorithms, Optical Coherent Communications, Optical Amplification/Repeaters, Nonlinearity/Polarization Technologies, Free-Space/Visible Light Transmission, Quantum, Communications/Encryptions, Optical Space Division Multiplex (SDM) Transmission

[Optical Communication Equipment]

Optical Amplifiers and Optical Repeaters, Optical/Electrical Cross Connect and OADM, Optical/Electrical Multiplexing and Demultiplexing, Optical Transceivers, Optical Terminals, Digital Signal Processing and Error Correction, Optical Communication Measurement, Optical Communication Equipment for Datacom

[Device Application to Optical Communication Systems]

Optical Signal Processing, Novel Functional Devices for Optical Communications, Photonic Integrated Circuits, Active Optical Devices, Passive Optical Devices, Optical Modules and Packaging, Optical Measurement Technologies, LSIs for Optical Communications

[Optical Communications Network/Specification]

Network Core/Metro Systems, Submarine Transmission Systems, Optical Access Systems/Next Generation PON, Ethernet, Optical Transport Network (OTN), Transmission Monitoring and Supervisory Control, Optical Transmission System Design/Tools, Mobile Optical Network

## **B-11. Communications Quality**

[Optimization and Control of QoE/QoS]

Game Theory, Data Mining, Personalization and Environmental Adaptation of Service, Network Control Considering QoE, Communication Behavior Model and Behavior Modification, Resource Allocation Optimization for Social Infrastructure, QoE and Business Model, User Engagement

[Evaluation and Measurement of QoE/QoS]

Subjective/Objective Evaluation, QoE Estimation Model, Psychological Assessment, Biological Information Measurement, Realistic/Ultra-Realistic, Usability, Crowdsourcing, Quality

- Visualization
- [Performance of Information and Communication Services]
  - IoT/M2M, Cloud/Fog Computing, DTN/Challenged Network, V2V/ V2X, Voice/Audio/Visual/Haptic Media, Web Service, Interactive System, Social Network Service
- [Network Performance]
  - Network Performance Indicator (KPI), Quality Measure and Standardization, Traffic Measurement/Planning/Control/ Management, Network Tomography, Cross-Layer Control, Green/Energy Saving Technology, Fairness, Reliability/Safety
- [Assessment, Measurement, and Control of Wireless Communication Quality]
  - Communication Quality of Mobile Communication, Communication Quality of Wireless LAN, Communication Quality of Sensor Network, Communication/Access Method, Wireless Resource Allocation, Optimization Control, Signal Processing, Efficiency of Frequency/Energy Usage

## B-12. Photonic Network

- [Photonic network device]
  - fundamental device technology, new material/new phenomena, packaging/housing technology, photonic switching, photonic signal processing, photonic label processing, wavelength conversion, photonic memory
- [Photonic network system]
  - photonic packet switching, photonic path/burst switching, optical multiplexing, optical interconnection, optical modulation/demodulation, photonic access technology, Ethernet technology, optical space communication
- [Photonic network control and management]
  - photonic network operation and management, photonic network planning, traffic engineering, SDN (OpenFlow etc.)/NFV, routing, signaling, inter-domain routing, network monitoring
- [Photonic network application]
  - low-delay high-speed application, huge contents transfer, high quality video transmission, grid computing, overlay network, transmission protocol for broadband communication application
- [Photonic network architecture]
  - Beyond IP network, cross-layer interworking, photonic network test bed, inter operability test, optoelectronic technology, power reduction technology, high capacity Data-Center network, flexible (grid) network

## B-13. Optical Fiber Technologies

- [Optical fiber sensing]
  - Optical fiber probe, Optical fiber gyroscope, Optical fiber sensor device, Distributed optical sensing, Remote optical sensing, Optical fiber measurement, Optical reflectometry
- [Optical fiber devices]
  - Optical signal/information processing, Optical fiber interferometer, Optical fiber amplifier, Optical fiber laser, Optical fiber coupler/splitter, Optical filter, Optical fiber device for various division multiplexing
- [Optical fiber systems]
  - Image/Illumination/Display, Material processing system, Medical system, Biological system, High-power system, Environmental system, Communication system
- [Optical fiber wiring/installing, maintenances/operations]
  - Testing system for optical line, Management for optical line, Reliability of optical line, Design of optical line, Construction technique for optical line, Optical connector/interconnection, Optical line components, Optical line/Optical connection for various division multiplexing
- [Design of optical fiber/cable]
  - Characterization of optical fiber, Reliability of optical fiber, Optical propagation analysis, Analysis of optical fiber character, Optical fiber cable/Optical fiber cord, Optical fiber for various use, Optical fiber/cable for various division multiplexing

## B-14. Technical Committee on Information Communication Management

- [Element and Network Management]
  - Mobile and wireless networks, IP networks, Software-defined networks, Access networks, Terminal management, M2M and IoT, Home networks, SON
- [Service and Business Management]
  - XaaS, Data service management, Hosting and collocation, Social network services, Cloud computing and data center, NFV, Business models, Law and ethics
- [Management Functionalities]
  - FCAPS, SLA and QoS, Event management, Policy based management, Autonomous management,

Agent based management, Security, Human interfaces  
[Operations and Management Technologies]  
Management models and processes, Monitoring and provisioning, Traffic engineering, DPI,  
Quality evaluations, Billing and accounting, Complex systems, Orchestration  
[Theories and Methodologies]  
Control theory, Optimization theory, Economic theory, Simulation techniques, Machine learning,  
Positivistic methodology, Development methodology, Open data

## B-15. Sensor Networks and Mobile Intelligence

[Sensing]  
Mobile Sensing/Sensor, Sensing Device/Embedded Software, Image/Acoustic Sensing,  
Environment Sensing, Vital Sensing, Energy Saving, Battery-less Systems, Energy Harvesting  
[Mobility]  
Connected Car, UAV/Drone, Wearable Computing, Mobility Management, Robot, Self-Driving,  
Car/Driving Assistance, Mobile Security, Activity Recognition/Estimation/Prediction/Control  
[Mobile/Ubiquitous Computing]  
Edge/Fog/Cloud, Machine Learning, Sensor Fusion, Database, Cyber-Physical/Ambient  
Intelligence, Swarm Intelligence, Sensor Mobile Data, Analysis/Processing  
[Sensor/Ad Hoc/Mobile Networks]  
IoT/IoE, Network Virtualization, M2M/D2D, V2V/V2I/V2X, Content Delivery Network, Software  
Defined Network, Information/Content Centric Network, Architecture/Protocol  
[Applications]  
Smart Mobility/ITS, VR/AR/Game, People Flow Analysis/Control,  
Medical/Health/Sports/Educational Assistant Systems, Smart City/Smart House, Smart Factory,  
Disaster Prevention and Reduction Systems, Construction/Agriculture/Forestry/Fisheries  
Industry Assistant Systems

## B-16. Internet Architecture

[Internet Case Studies and Social Implications]  
Green IT, Educational Case Study, Medical Case Study, Support for the Aged and the Challenged,  
Business Continuity, Copyright Protection, Internet Broadcasting, Network Neutrality  
[Internet Interconnection, Operation and Management]  
Internet Operation and Management Technologies, Automatic Configuration, Traffic Control  
Technologies, Scalability, Interoperability, QoS, Identity Management, Enterprise Network,  
Campus Information Systems  
[Network Architecture and Protocol]  
New Generation Network, Overlay and P2P Network, Multihome, Network Virtualization, IPv6,  
Routing, Transport Protocol, Wireless Internet Protocol, Mobility Support  
[Internet Application and Middleware]  
R&D Testbed Construction and Utilization, Sensor Application, Video Streaming, Open  
Technology, Mashup, Rich Client, Cloud Computing  
[Internet Security]  
Security Policy and Information Ethics, Personal Information Protection, E-mail and Anti-SPAM,  
Traceback Technologies, VPN (Virtual Private Network), PKI (Public Key Infrastructure),  
IDS/IPS (Intrusion Detection/Protection System)

## B-17. Smart Radio

[Software radio]  
software radio architecture, wideband/multi-band antenna, reconfigurable RF circuit, high speed  
and high efficiency AD & DA converter, reconfigurable logic device, blind signal detection, adaptive  
communication, software download and security  
[Cognitive radio]  
spectrum sensing, global roaming, dynamic spectrum access, channel aggregation, media access  
control for cognitive radio, load balancing, cognitive network  
[Wireless distributed network]  
cooperative sensing, spectrum sharing, active and passive interference cancellation, distributed  
MIMO, adaptive resource allocation, cooperative communication, cross layer optimization,  
synchronization for distributed network  
[Wireless transceiver implementation]  
software radio transceiver, cognitive radio transceiver, implementation of wireless signal  
processing, prototype hardware, radio regulation approval test, interoperability test, middle ware,

application program interface

## B-18. Short Range Wireless Communications

[Propagation and Antenna]

indoor radio propagation, outdoor radio propagation, propagation in cars, portable (omnidirectional) antenna, beamforming, channel model, MIMO.

[Physical Layer]

modulation/demodulation, error correction technique, synchronization, equalization, OFDM, MIMO, RF TRX, interference cancellation, radar

[MAC]

CSMA/CA, MAC for high speed communication, MAC for wide-coverage sensor network, MAC for medical wireless system, interference avoidance, pico-net, ad-hoc, dynamic spectrum access

[Network / Security]

machine to machine (M2M) communication, TVWS, smart grid, multi-hop network, near field communication (NFC), wireless sensor network, wireless personal area network (PAN), positioning

[Implementation]

ASIC technology, millimeter wave RF CMOS, compound semiconductor RF, low noise RF receiver, low power consumption HW implementation techniques, low power consumption SW coding technique, small and feathery HW implementation technique

## B-19. Healthcare and Medical Information Communication Technology

[PHY/MAC Technologies for Healthcare and Medical Applications ]

medical communication, ranging and sensing in physical layer, medical access Control and Error-control, protocol in MAC layer, channel modeling, medical equipments and devices, Vital Sensors, medical actuators, wearable and implant sensors and devices

[Network Technologies for Healthcare and Medical Applications ]

healthcare and medical network architecture, routing, topology, M2M, IoT, medical fault tolerancy

[Applications Related to Healthcare and Medical ICT ]

healthcare and medical security (encryption, authentication), user interface, medical network management, software, vital signal processing, image processing, body area network (BAN), sensor network, infrastructure network, satellite network, energy network, wearable game and entertainment

[Design Technology for Ensuring Human Safety for Healthcare and Medical Applications ]

EMC design, radio safety guideline, specific absorption ratio (SAR), medical antenna, transducer, devices, components, package, shield technologies

[Information Sharing and Protection of Personal Information ]

medical information sharing, protection, strategy for global social services, standardization, instruction and guides for clinical staffs, safety guideline for medical devices, medical ethics, regulatory science for medical equipments and devices (radio regulation, clinical and pharmaceutical affairs, PL law)

## B-20. Wireless Power Transfer

[Novel Transmission Optical Fibers]

Ultra-high-power Transmission Optical Fibers, Optical Fibers for Space Division Multiplexing, Optical Fibers for Mode Division Multiplexing, Multi-core Optical Fibers, Multi-mode Transmission Optical Fibers, Novel Splicing Technologies, Novel Optical Connectors

[Ultra-dense Multiplexing/Transmission Technologies]

Space Division Multiplexing/Mode Division Multiplexing Transmission, Novel Modulation Formats, Signal Processing, MIMO Processing, Optical Amplifiers for Space Division Multiplexing

[Novel Optical Node Architecture]

Exa-class Node Architecture, Exa-class Switching Technologies, Exa-class Optical Node Control Technologies

[Ultra-high-capacity Optical Submarine Cable Systems]

Petabit-class Optical Submarine Transmission Technologies, Petabit Cable Technologies, Petabit Optical Amplifiers

## C: Electronics Society

### C-1. Electromagnetic Theory

Fundamental Theory of Electromagnetic Fields, Mathematical Analysis Theory and Its Applications, Numerical Techniques, Computational Electromagnetics, Quantum Electrodynamics, Radiation, Propagation, Scattering and Diffraction, Periodic Structures, Theory and Analysis of Random Media, Guided Wave Theory and Analysis of Waveguides, Electromagnetics in Information Processing, Coupling Theory and Application of Other Systems, Nonlinear Problems, Inverse Problems.

### C-2A. Microwave and Millimeter Wave Active Devices and Circuits

Devices and circuits and their fabrication technologies, design theories, simulation analyses and measurement techniques for oscillators, amplifiers, mixers, frequency multipliers, frequency dividers, detectors, phase shifters, switches, etc.

### C-2B. Microwave and Millimeter Wave Passive Devices

Devices and their fabrication technologies, design theories, simulation analyses and measurement techniques for waveguides, circuit elements, resonators, filters, power combiners/dividers, directional couplers, multiplexers/demultiplexers, ferrite/nonreciprocal circuits, functional materials, etc.

### C-2C. Microwave and Millimeter Wave Systems and Subsystems

Radar systems, communication systems, sensor and imaging systems, holographic systems, microwave heaters, medical applications, etc.

### C-3/4. Optoelectronics / Lasers and Quantum Electronics

Photonic integrated circuit (dielectric), optical waveguide device (any material), modeling of optical waveguide, optical fiber (including multi-core, multimode, special fiber, and connection technology), optical module, optical interconnection, optical sensor, optical measurement, optical memory, optical information processing, optical signal processing, optical switch and modulator (dielectric), free space optical device (including MEMS), photonic crystal (passive), opto-electronic integrated circuit, hybrid integration, all optical processing, silicon photonics.

[Active photonic device (including device-oriented optical module)]

Semiconductor laser, light-emitting diode, optical amplifier (semiconductor, fiber amp.), fiber laser, optical switch and modulator (semiconductor), optical detector (semiconductor and etc.), optical integrated circuit (semiconductor), active photonic crystal, wavelength conversion, optical soliton, ultra-short optical pulse, THz equipment and device.

[Optical fundamental technology]

nonlinear optics, phase conjugate optics, quantum optics, laser spectroscopy, semiconductor epitaxial growth and process for optical device, optical material property.

### C-5. Electromechanical Devices

Contact phenomena, Electrical discharge phenomena, Contact components and their materials, Spring and mechanical systems, and their materials, Electromechanical conversion systems, such as small motors and their materials, Electromechanical components and optical-electro-mechanical components, such as relays, switches and connectors and optical, Opto-mechatronics, Information input-output devices, Other electromechanical components, Mounting technology of electromechanical components and devices

### C-6. Electronic Component Parts and Materials

Dielectric, piezoelectric, magnetic and organic materials; Conductors and semiconductors; Photonic materials and man-made photonic crystal; Other electronic materials and material science; Sophisticated methods for crystal growth and fabrication of thick or thin films; Sensors, recording devices, display devices and hybrid integrated circuit devices; Electrochemical materials and batteries; Packaging technology and design technology for electronic components; Evaluation and analytical technology for electronic components, and evaluation technology of reliability

### C-7. Magnetic Recording

Principles of Information Recording (Magnetic, Optical and Others), Recording Theory and Modeling, Recording Materials and Components (Recording Media, Heads etc.), Signal Processing and Channels for Recording, Servo, Tribology, Information Storage Equipments and Systems, Recording System Analysis and Measurement Technology, Other Recording Related Technologies

### C-8. Superconducting Electronics

Superconducting integrated circuits (Single-flux-quantum digital circuits, Digital/analog mixed circuits, etc.), Superconducting sensing devices (SQUIDS, SSPDs, SIS mixers, STJs, MKIDs, TESs,

etc.), Superconducting quantum metrology devices (Voltage standards, Current standards, etc.), Superconducting quantum computers, Superconducting passive devices (Filters, etc.), Superconducting device fabrication technology (Thin-film technology, Josephson-junction technology, etc.), Circuit design technology, Jisso and system technology (High-frequency mounting technology, Cryogenic-temperature mounting technology, Cooling technology, etc.), Superconducting device applications (Information processing, Communications, Measurement and analysis, Medical and biological systems, etc.)

## C-9. Electronic Displays

Emissive displays, Non-emissive displays, Printers, Display devices and systems, Driving elements, circuits and systems, Human engineering for displays, Display materials, parts, manufacturing technology.

## C-10. Electron Devices

[Electron devices and integrated circuits]

Optical communication, Mobile communication, Microwave, Millimeter wave, Ultra-high speed digital, Imaging sensor, Display, High-power device

[Device type]

FET, HEMT, HBT, Bipolar device, Diode, Power device (IGBT, Thyristors, etc.), TFT, MOS•MIS•Schottky devices, Solar cells, Sensors, Quantum effect devices, Single-electron devices, CNT devices, Vacuum nanodevices, Electron tubes, MEMS, Filters, Other novel devices

[Materials]

Compound semiconductors (III-V, III-IV etc.), SiGe, SiC, Diamond, Carbon, Amorphous semiconductors, Poly-type semiconductors, Oxide semiconductors, ferroelectrics and paraelectrics, Superconductors, Organic materials, Other electric materials

[Process technology]

Crystal growth, Heterojunctions, Nanostructures, Control of surfaces and interfaces, Electrodes, Passivation, Beam application

[Modeling and simulation]

Device/process, Thermal, Stress, Circuit, etc.

[Phenomena in electron devices]

Carrier transport, Distortion, Noise, Nonlinear phenomena, Chaos etc.

## C-11. Silicon Device and Materials

(Material • Process Technology • Reliability)

silicon devices, LSI production materials (single crystal silicon, poly crystal silicon, amorphous silicon, epitaxy, crystal defects, impurities, wafer process, refractory metals, metallic silicides, resist, dielectrics, packaging materials, super clean water, high purity gas, high purity chemicals), and these characterization, device • process technologies, tool technologies, high density and large scale integration technologies (lithographies, fine patterning, surface treatments, process clean, etching, spatter, CVD, impurity diffusion, ion implantation, device isolation, planarization, multi-level wiring, SOI, selective growth), production yield and reliability problems (hot carrier effect, electromigration, stress migration, radiation-resist, defect check, passivation)

(Device Structure • Characterization)

bipolar transistor, FET, MOS, CMOS, BiCMOS, SIT, TFT, dynamic memory cell, Nonvolatile memory cell, high speed devices, large scale integrated devices, Low temperature operated devices, analogue devices, radiation-resistant devices, Power devices, 3-dimensional devices, SOI devices, Si-hetero devices, various sensors, solar cell, wafer scale device, Si quantum effect devices.

(Simulation • Modeling)

process • device simulation, process • device modeling, particle model simulation, Integrated simulation system.

## C-12. Integrated Circuit and Devices

[Memory Integrated Circuits, Memory]

Memories (DRAM, SRAM, Flash Memory), Functional Memories (CAM, Intelligent Memories), Special Purpose Memories (Video Memories, Switch Fabric, FIFO).

[Analog Integrated Circuits, Analog]

A/D Converters, D/A Converters, Operational Amplifiers, Comparators, Filters, CCD, Analog Neural Networks, Mixed Signal LSI, LSI Sensors.

[Digital Integrated Circuits, Digital]

Microprocessors, Microcontrollers, Application Specific Processors, Digital Signal Processors, Custom LSI/ASIC, AI Processors, Digital Neural Networks, Clocking Technologies, Interface Technologies.

[Integrated Circuit Design, Test, and Assembly Technologies]

VLSI Design Technologies, Design for Testability, Testing and Evaluation Technologies, Assembly

Technologies(LSI Packages, TAB, MCM).

### **C-13. Organic Molecular Electronics**

Molecular Electronic Device, Molecular Device, Organic Transistor, Liquid Crystal Display Device, Organic Electro-Luminescence Electroluminescence (EL) Device, Organic Electronic-Paper, Organic Photosensitizer, Organic Film Sensor, Biosensor, Gas • Ion-Sensor, Bio-Tip, Light Wave guide, Photo Switch, Photo Connector, Photo Refractive Device, Electrolytic Condenser, Light Guide, Organic Solar Cell, Organic Photovoltaic Cell, Polymeric Battery, Organic Radical Battery, Molecular Memory, Organic Optical Recording, Ultra-fine Processing Resist, Photo Chemical Hole-Burning, Artificial Muscle, Organic Semiconductor, Organic Conductor, Organic Insulator, Organic Superconductor, Organic Magnetizer, Liquid Crystal, Organic Phase-transition Material, Organic Non-linear Material, Organic Nano-Material

### **C-14. Technical Committee on Microwave Photonics**

Microwave, millimeter-wave, sub-millimeter wave optical devices and driving circuits; Generation and control of microwave and millimeter-wave and ultrafast electrical signals based on optical techniques; Generation of optical LO; Optical spectral synthesis; Hybrid photonic and microwave devices and subsystems; Transmission of microwave and millimeter-wave using optical fiber (ROF: Radio on fiber); Fiber-driven wireless access systems; Optically controlled antenna and phased arrays; Optical wireless applications; Measurement of microwave and millimeter-wave using optical means; Application of microwave photonics for free space and astronomy; Terahertz wave and applications; Bandgap structures for optical wave and microwave and their applications; MEMS technology for microwave photonics

### **C-15. Electronics Simulation Technology**

Techniques on computer simulations for electronic engineering (electromagnetic theory, circuits, semiconductors, electronic systems, etc.), Acceleration techniques on computer simulations, Comparison and estimation of simulators (standard problems for the comparison/estimation), Global modeling, Multi-physics simulation, Standard computer platforms for simulators, Simulators for educational purposes (electromagnetic theory and so on).

## **D: Information and Systems Society**

### **D-1. Theory of Computation**

Computability Theory, Complexity Theory, Automata Theory, Formal Language Theory, Transformation and Verification of Computation, Graph Theory, Combinatorics, Algorithms and Data Structures, Quantum Computing, Molecular Computing, Distributed Computing, Parallel Computing, Theoretical Foundation of Artificial Intelligence, Computational Learning Theory, Discovery Science, Coding Theory, Theory of Cryptography, Symbolic Computation, Computational Geometry, Computational Biology, Discrete Optimization, Mathematical Programming, Metaheuristics, Theory of Complex Networks, Algorithms for Big Data.

### **D-2. Neuro Computing**

computational theory of neuroscience, neural network model, modeling of perception, cognition, behavior, and thought modeling of memory, learning and inference, modeling of motion control, internal representation of neural information, neuro-computing architecture and related devices, parallel distributed processing model of the neural system, computational neuroscience, cognitive science, visual and auditory psychophysics, visually-guided robot with audio equipment

### **D-3. Software Science**

Programming Languages & Processing Systems, Program Specification & Verification, Programming Methodology, Software Engineering, Software Metrics, Software Reliability, Software Testing, Object-Oriented Development, Software Development Environments, Computation Models, Concurrent & Distributed Processing, Real-Time Processing, Operating Systems

### **D-4. Data Engineering**

Data Models, Database Languages, Database Design Methodology, Designing and Implementing Database Systems, Distributed Databases, Database Machines, Deductive Databases, Object-Oriented Databases, Multimedia Databases, Stream Databases, Transaction Processing, Information Retrieval, Information Resource Management, Databases and WWW, XML Databases, Data Warehousing, Data Mining, Advanced Database Application, Sensor Database, Database and Big Data, Data-oriented Social Computing, Database and Crowd Sourcing.

### **D-5. Natural Language Understanding and Models of Communication**

Fundamental natural language processing techniques (parsing, lexical acquisition, machine learning), Text Mining (opinion mining, exploiting collective intelligence, medical information analysis), Application (usage of analytics tools for real business, voice of customer analysis)

### **D-6A. Computer Systems A (Architecture)**

Computer Architecture, High Performance Computing, Low Power Technology, Reliable System, Embedded System, Accelerator, Multicore, Many Cores, Virtualization, Utilization of New Devices, Vector Processor, Multithreading, Transactional Memory, Auto-Memoization, Reutilization, Sperscalar, VLIW, Memory Hierarchy, Cache, Emulation, Network on Chip, System on Chip, High Precision Unit, Timing Violation Detection, Prediction, Speculation

### **D-6B. Computer Systems B (Hardware)**

Power Unit, Storage, Input/Output Device, Non-volatile Memory, Diagnostics and Maintenance, Operation Technique, Test Program

### **D-6C. Computer Systems C (Software)**

Virtual Machine Monitor, Operating System, Compiler, Interpreter, Binary Translation, Middleware, Firmware, Library, Database Management System, Application Program, Accelerator Application, Annotation, Low Power Software

### **D-7A. Medical Engineering and Biocybernetics A (Biocybernetics)**

Molecular bioengineering, Hormonal and Immune systems, Cell fusion and Biotechnology, Biocomputer, Measurement and Application for Cellular system function, Novel measuring method for Brain and Neural systems, Neural and Physiological systems Analysis, Information processing in Brain and Sensory system, Psychological/Physiological Engineering analysis on Sensory system, Physiological engineering of Memory, Learning, and Self-organization, Psychophysical measurement and analysis, Model and Simulation in Biological system, Fluctuation and Rhythm in Biological system, Analysis on Movement and Control in Biological system, Biomechanics

## D-7B. Medical Engineering and Biocybernetics B (Medical Engineering)

Medical monitoring for human, Clinical Biosignal processing, Medical engineering for Ophthalmology, Dentistry and Obstetrics, Medical sensor, transducer and telemeter, Biomagnetics, Electromagnetic environment, and Hyperthermia, Medical Ultrasonic engineering, Medical optics, Artificial organ, Biofunction substitution, and Prosthetic engineering, Biocontrol, Biofeedback, Rehabilitation engineering, Medical image processing and measuring, Development and Analysis of Medical instrument system, Medical diagnosis and expert system, Medical informatics, Human, behavioral and psychological Engineering, Space medicine, Medical safety and Clinical Engineering

## D-8. Artificial Intelligence and Knowledge Engineering

Intelligent Communication, Intelligent Agent, Agent Communication, Intelligent Groupware, Intelligent Interface, Knowledge Media, Intelligent CAI, Artificial Life/Intelligent Robot, Cooperative Problem Solving, Knowledge Sharing and Reuse, Knowledge Engineering and Expert System, Knowledge Representation and Inference, Knowledge Acquisition and Learning, Distributed / Parallel Artificial Intelligence, Genetic Algorithm, AI Applications

## D-9. Life Intelligence and Office Information System

Lifelog (Practical Use of Lifelog, Life Intelligence, Lifelog Data Analysis), Office Model (Office Model, BPR, Information Sharing, XML, Documentation Structure, Document Processing, Work Flow), Communication Technology for Work Sharing (E-Mail, Groupware, CMS, Blog, SNS, Virtual Sharing Environment, Virtual Office), Data Mining for Lifelog and Office Information (Behavior Analysis, User State Estimation, Customer Information Mining, Knowledge Management, Mail Mining, AI Application), System Architecture (Web Service, Information System Guideline, SOA, WebAPI, RSS, Mashup, SLA, Cloud Computing, SaaS, PaaS, IaaS), Network (Sensor Network, Ubiquitous Network, VPN P2P), Security (Anonymization Technology, User Profile Handling, Access Control, Computer Virus, Spam, Copyright Management), Human Interface (Visualization, Mobile Interface, Rich Interface, Ajax), Office Application (Decision Support, Campus Information System, CTI, CRM, Internet Home Electronics, IPTV)

## D-10. Dependable Computing

dependable computing (dependable system, dependable computing system, dependable computer, dependable network, dependable software, dependable hardware, etc.), fault-tolerant system, (parallel / distributed / cooperative system, operating system, database system, real-time system, assurance system, computer network, system design methodology / tool, etc.), fault-tolerant software (programming, data structure, interprocess communication and synchronization, transaction processing, exception handling, system reconfiguration, error recovery, etc.), fault-tolerant hardware (fault prevention, fault masking, fault detection / diagnosis / reconfiguration, functional recovery, failsafe, error detection / correction code, defect avoidance design, VLSI related, etc.), design / verification / testing (test generation, design for testability, test synthesis, self testing, fault diagnosis, fault verification, program verification / testing, protocol verification / testing, logic / fault simulation, etc.), reliability / safeness / performance evaluation (system reliability, system safeness, analysis model, simulation, measurement / evaluation method, performance evaluation tool, etc.), maintenance and diagnosis, remote diagnosis, fault-tolerance application technology (process control, robotics, neural network, fuzzy system, factory automation, office automation, medical system, etc.)

## D-11A. Image Engineering

(Basic image technology, Image coding, Image representation, quality assessment) Image information theory, Image/video coding, Source coding, Quantization, UHDTV, Superresolution, High dynamic range/high frame rate video, Multi-view video/free viewpoint video, Holography, Computational photography, Human visual system, Image quality assessment, Color engineering, Multi-spectral image, Graph signal processing, Image restoration, Image features.

## D-11B. Image Engineering

(Image/video applications, Image processing, Image sensing) Image processing algorithm, Document-image processing, 3D image input/output technology, CG applications, Projection, VR/AR, Image sensing algorithm.

(Transmission, Network) Video transmission, Video network, Adaptive streaming, Video codec, Mobile TV, IPTV, P2P

(System, Multimedia applications) Equipment/systems for image processing/ display/ acquisition/ conversion/storage/printing, Multimedia application technology.

## D-12A. pattern recognition and media understanding A(recognition, understanding,

## and synthesis of pattern media)

recognition, understanding, and synthesis of documents, characters, graphics, drawings, maps, multimedia; digital library; media conversion; human vision; perception model; cognitive model; pattern generative model; recognition and understanding theory; understanding model; learning theory; feature extraction; discrimination theory; image segmentation; pattern analysis; pattern representation; pattern matching; learning mechanism; self-organization system; neural network; embedded hardware; software library; pattern database; pattern dictionary; intelligent pattern media.

## D-12B. pattern recognition and media understanding A(recognition, understanding, and synthesis of pattern media)

image and video recognition, understanding and synthesis; 3-D reconstruction; sensor fusion; regularization; active vision; motion analysis; robot vision; object recognition and environment understanding; virtual environment synthesis; application of computer vision to virtual reality; intelligent graphics; animation; multimodal interface; embedded hardware; software library; intelligent robot.

## D-13. Knowledge Based Software Engineering

Web Services, Development tool for expert systems, XML, Enterprise Modeling, Object oriented software engineering, ontology, Formal and semiformal specifications, CASE, Software architecture, Intelligent support for software development, Software development process, Education of software engineering, Software reuse, Knowledge representation/acquisition/management/utilization, Intelligent agent, Intelligent CAI, Intelligent human interface, Domain analysis and modeling, Business Modeling, Programming knowledge, Programming semantics, Program understanding, Distributed cooperative software development, Model-driven architecture, Ubiquitous software engineering, Requirements engineering, Workflow.

## D-14. Speech and auditory processing

theory of speech processing, speech production, speech perception, speech quality assessment, speech analysis, feature extraction of speech, synthesis of phonological unit and prosody, text to speech (TTS), speech recognition, speech understanding, spoken dialog modeling, spoken language processing, knowledge processing for spoken language, singing information processing, compression of speech signal, high density speech recording, signal processing for speech, speech technology for welfare, language education, speech input and output device, human auditory system, auditory function, auditory model, auditory information processing.

## D-15. Educational Technology

educational information, CAI, ITS, CMI, knowledge information processing and education, database technology and education, simulation technology and education, network for educational information, electronics, information and communication technology and education, educational equipment · system · media, distance education, multimedia environment, information-processing education, computer literacy, educational evaluation, curriculum development, educational environment, technology transfer, human factor, human function measurement, audio-visual education technology, human interface in education, presentation technique, education of physically and mentally handicapped children, inhouse education

## D-16. Medical Imaging

Image Science and Image Information Theory pertinent to Bio-Medical Imaging, Bio-Medical Imaging Instrumentation (CT, MRI, US, RI, Functional Imaging, Dynamic Imaging, etc.) and its basic techniques such as Signal Detection/Mesurement/Processing, Bio-Medical Image Display, Man-Machine Interface for Diagnostic Imaging or Image Guided Therapy, Virtual or Mixed Reality for Medical Application, Pattern Recognition and Understanding of Medical Images, Medical Image Compression/Transmission/Archiving/Searching (Theory, System, Basic Technique, etc.), Computer Aided Diagnosis of Medical Images, Image Guided Surgery, Surgical/Treatment Planning, Virtualized Endoscopy System, Navigation-based Diagnosis, Medical Image Systems (PACS, Tele-medicine, RIS, HIS, 3D-Atlas, Education, etc.), Medical Image and Somatics

## D-17. Software Interprise Modeling

Enterprise Models (Model Creation <Model Elements and Relationship>, Modeling Processes and Methodologies, Model Evaluation, Value Planning Models and Modeling Methodologies, Competitive Models and Corporate Strategies, Model Enaction <Methods and Supportive Circumstances>, Reference Models in each Industry, and e-Government), e- or E- Business Models (Creation Processes <Business Methods, Business Architectures, Business Processes>, Modeling Methods/Methodologies,

Evaluation Methods, Modeling Approaches <from Viewpoint of Software Engineering, Systems Engineering, Industrial Engineering and Management, and Social Sciences>, and Business Method Patents), Information Models and Software Models (Creation Processes <Architectures and others>, Modeling Methods/Methodologies, Software Reuse Technologies, Software Processes, Software Development and Runtime Environments), and Related Topics (Infrastructures for e-Businesses <Fundamentals and Implementations>, Information Security and Integrity, Quality Management, Project Management, Problems and Solutions in Software Industries, Human Resource Development and Qualification).

## **D-18. Reconfigurable Systems**

Reconfigurable System Technologies (Architectures, Devices, Algorithms, Design Technologies, Development Platforms), FPGA/PLD Technologies (Devices, Circuits, Design Technologies, Low Power Technologies), Configurable Processors, Dynamically Reconfigurable Processors, Dynamically Adaptable Architectures, FPGA/Processor Cooperative Processing Technologies, Emulation Technologies and Rapid Prototyping, and Related applications (Numerical calculation, Image processing, Big Data Processing, etc.).

## **D-19. Information and Communication System Security**

Security technologies related on {Network, Ad-hoc Network, P2P, Sensor Network, RFID, Wireless LAN, Mobile Network, Home Network}, DoS/DDoS Attack Detection, Bot/Bot Network Detection, Traceback, Access Control, Contents Security, DRM, CDN, Privacy Protection, E-Commerce, PKI, Security Architecture, Security Protocol, Security Implementation Technologies, Secure OS, Security Evaluation.

## **D-20. Information Based Induction Sciences and Machine Learning**

Learning Theory (information theoretic/computational/statistical/statistical physical learning theory), Machine Learning Methodologies (supervised/unsupervised/semi-supervised learning, PAC learning, on-line learning, Bayes learning, model selection, kernel methods, boosting, distributed cooperative learning, agent learning, singularities, optimization, regularization, active learning, stochastic complexity, game-theoretic learning, computational statistics (Markov chain Monte Carlo, variational Bayes, annealing), etc.),

Machine Learning Applications (signal processing, pattern recognition, bioinformatics, medical science, language/image/speech processing, financial engineering, robotics, brain information processing, neural systems, system biology etc.),

Data Mining (Graph mining, web mining, text mining, stream mining, network mining, sensor mining, privacy-preserving mining, large-scale computation, anomaly detection, business data analysis, etc.)

## **D-21. Enriched Multimedia**

Protecting Values of Digital Content (media security, content security, digital rights management, integrity verification, digital forensics, privacy enhancing technologies, content delivery network, access control, secure communication, anonymous communication, secret sharing, obfuscation, digital watermarking, digital fingerprint, steganography, steganalysis), Enhancing Values of Digital Content (content integration, media fusion technologies, cross-media search, multimedia archive system, content processing, media recovery, multimedia annotation, automatic multimedia summarization), Creating Values of Digital Content (content design, reality creation, universal media, digital entertainment), Measuring Values of Digital Content (content evaluation, image and sound quality evaluation, metrics for perception and cognition, human auditory and visual system)

## **D-22. Cloud Network Robotics**

[Networked Robot Cooperation and Collaboration]

Heterogeneous networks cooperation, sensor network, robotic service cooperation, tele-operation, tele-presence, robot safety assurance, semantic network, cloud sourcing

[Human-Robot Interaction]

Human-robot communication (verbal/ non-verbal), media recognition and understanding, natural language understanding, multi-modal interface, situation recognition/ classification, behavior recognition/ classification, communication behavior generation, cognitive science, brain/neuro science, social behavior model, knowledge processing, ontology

[Cloud Data Integration for Networked Robot (NR)]

Cloud service security, personal information utilization, robot ethics, legal restriction, ambient intelligence, geometric information for NR, user property and personal information management, cloud data mining, bigdata analytics, machine learning, inference/prediction, visualization, simulation, standardization

## D-23. Services Computing

[Service]

Smart Service, CPS, smart application, Web API / API Economy, SOA, service composition, SLA, BPM, micro service, crowdsourcing, mobile service, business model / service economics

[Cloud]

SaaS, PaaS, IaaS, service Deployment / operation / management, container, hybrid cloud, multi-cloud, cloud native, development methodology (cloud first)

[BigData]

Big data analysis platform, big data analysis service, linked data service, ontology / semantic web, open data

[IoT]

IoT architecture, IoT platform, smart device, smart electrical appliance, edge computing, fog computing