IoT Technologies

Security
- Access Control
- Awareness and Training
- Audit and Accountability
- Security Assessment and Authorization
- Configuration Management
- Contingency Planning
- Identification and Authentication
- Incident Response
- Maintenance
- Media Protection
- Physical and Environmental Protection
- Planning
- Personnel Security
- Risk Assessment
- System and Services Acquisition
- System and Communications Protection
- System and Information Integrity
- Program Management
- Privacy
  - Data-Driven Privacy

Time Synchronization
- Clock
  - Oscillator Type
    - RC Oscillator
      - Free Running
    - Crystal (XT) Oscillator
      - Controlled
        - Oven Controlled
        - Voltage Controlled
        - Temperature Controlled
        - Calibrated Dual Crystal
      - Mechanical (MEMS) Oscillator
      - Pendulum / Balance Wheel
      - Atomic Oscillator
  - Oscillator Properties
    - Frequency
    - Phase
    - Drift/Stability
- Reference
  - Transmission Methods
    - Global Navigation Satellite System (GNSS)
    - Modern (Automated Computer Time Service (ACTS))
    - Optical Timecode Broadcast
    - Radio Timecode Broadcast
    - Internet
  - Local Reference Clock
    - Astronomical
      - Universal Time Coordinated (UTC)
      - Greenwich Mean Time (GMT)
    - Atomic
      - National Atomic Reference (NIST F-2, NPL Cesium, USNO Master Clock, etc.)
      - International Atomic Time (TAI)
  - Peers (Consensus)
  - Standards
  - Hardware
    - Frequency Locking (Synchronization)
    - Phase Locking (Synchronization)
    - Temperature Drift Compensation
  - Algorithms
    - Software
      - Reference Clock Selection
      - Clock Disciplining Algorithms
      - Anomaly Detection
      - Leap Second Compensation
      - System Management
      - Peer Management
- Timestamp
  - Time Formats
    - Local/Customized
    - W3C Date Time Format
    - XML Schema Date Time
      - ISO 8601
      - RFC 822
    - Posix Time / Epoch Time
  - Traceability
    - Hardware
    - Firmware
    - Software
  - Implementation
    - Resolution
    - Epoch
- Time Distribution Methods
  - 10 MHz Analog Reference Signal
  - Pulse-Per-Second (PPS) Signal
  - Mode Locked Optical Signal
  - Inter-Range Instrumentation Group (IRIG)
  - Network Protocols
    - Simple Network Time Protocol (SNTP)
    - Network Time Protocol (NTP)
    - Precision Time Protocol (PTP)
      - White Rabbit
      - Telecom Profile
      - Power Profile
      - Reference Broadcast Time Synchronization (RBS)
      - Time Protocol, Daytime Protocol
- Performance
  - Accuracy
    - Offset
    - Jitter
    - Convergence Rate
  - Availability
    - Local Area
    - Wide Area
    - Wireless
    - Wired
    - Interoperability
    - Oscillator Holdover
    - Time Code Integrity
    - Reference Clock Authentication
    - Backup Reference Clock
  - Security

Management Functions / Risk Management
- Network Management
- Device Management
- Resource Management
- Service Management
- Security Management
- Privacy Management
- Safety Management
- Business Management
- Quality of Service (QoS) Management
- System Monitoring
- Cross-Layer Management

Computing
- Complex Systems
  - Self Organization
    - Adaptation
      - Short Term (Flexibility)
      - Long Term (Evolution)
    - Resilience
      - Short Term (Robustness)
      - Long Term (Survivability)
    - Pattern Spreading
      - Principle of Least Action
      - Space
      - Time
      - Spatiotemporal
    - Self Similarity
      - 1/f Noise
      - Long-Range Dependence
      - Auto-Correlation
      - Fractals
    - Measurement Signals
      - Critical Slowing Down
        - Entropy
        - Minimum Description Length
        - Kolmogorov Complexity
      - Information Theory
  - Self-Organizing Design
    - Emergent Behaviors
      - Social Models
        - Swarms
        - Stigmergy
        - Biological Models
        - Self-Interest
        - Altruism
        - Socialism
        - Communism
        - Game Theory
        - Catallaxy
      - Economic Models
        - Equilibrium
        - Oscillation
        - Self-Organized Criticality
        - Phase Transition
          - Punctured Equilibrium
          - Metastability
          - Chaos
- Information Integration
  - Physical & Chemical Models
    - Electromagnetism
    - Thermodynamics
    - Molecular Equilibrium
    - Diffusion
    - Phase-Transition Resistance
    - Data Compression
    - Data Encryption
    - Data Layout
      - Deduplication
      - Record and Block Layout
      - Extraction, Transformation, and Loading
      - Data Exchange
      - Data Cleaning
      - Wrappers (Data Mining)
      - Mediators and Data Integration
      - Entity Resolution
      - Data Warehouses
      - Federated Databases
  - Data Structures
    - Multidimensional Range Search
      - Multidimensional Range Reach
      - Data Scans
      - Point Lookups
      - Unidimensional Range Search
      - Proximity Search
    - Data Access Methods
  - Middleware for Databases
    - Database Web Servers
    - Application Servers
    - Object-Relational Mapping Facilities
    - Data Federation Tools
    - Data Replication Tools
    - Distributed Transaction Monitors
    - Message Queues
    - Service Buses
    - Enterprise Application Integration Tools
    - Middleware Business Process Managers
  - Database Management System Engines
    - DBMS Engine Architectures
      - Database Query Processing
        - Query Optimization
        - Query Operators
        - Query Planning
        - Join Algorithms
      - Database Transaction Processing
        - Data Locking
        - Transaction Logging
        - Database Recovery
        - Record and Buffer Management
        - Key-Value Stores
        - Relational Parallel and Distributed DBMSs
        - Triggers and Rules
        - Database Views
        - Integrity Checking
        - Distributed Data Locking
        - Deadlocks
        - Distributed Database Recovery
        - Distributed Database Transactions
        - Main Memory Engines
        - Online Analytical Processing Engines
        - Stream Management
        - Graph-Based Database Models
          - Hierarchical Data Models
          - Network Data Models
          - Semi-Structured Data
          - Relational Database Model
            - Data Streams
            - Data Provenance
            - Incomplete Data
            - Temporal Data
            - Uncertainty
            - Inconsistent Data
            - Entity Relationship Models
            - Physical Data Models
            - Data Model Extensions
      - Theory of Database Privacy and Security
      - Incomplete, Inconsistent, and Uncertain Databases
    - Design and Models
    - Database Administration
      - Database Utilities and Tools
      - Database Performance Evaluation
      - Autonomous Database Administration
      - Data Dictionaries
    - Query Languages
      - Structured Query Languages
        - Relational Database Query Languages
        - XPath
        - XQuery
        - XML Query Languages
        - MapReduce Languages
        - Query Languages for Non-Relational Engines
        - Call Level Interfaces
    - Discoverable Items
      - Service Descriptions
        - Repository Descriptions
        - Administrative Scopes
        - Service Types
      - Configuration Discovery and Monitoring
        - Lazy Discovery
        - Aggressive Discovery
        - Directed Discovery
        - Monitoring Discoveries
      - Registration and Extensions
        - Registration Types
        - Registration Process
        - Extension Process
      - Service-Description Discovery and Monitoring
        - Service-Description Discovery with Repositories
        - Service-Description Monitoring with Repositories
          - Notification
          - Polling
        - Service-Description Discovery without Repositories
        - Service-Description Monitoring without Repositories
        - Discovery Consistency
          - Primary Discovery
          - Secondary Discovery
        - Consistency Guarantees
          - Registration Consistency
          - Update Consistency
          - Discovery Discard
          - Description Discard
          - Registration Discard
            - Discard Consistency
          - Extension Policy
            - Fixed Assignment
            - Random Assignment
            - Requested Assignment
            - Adaptive Assignment
            - Priority Assignment
            - Replica Selection
              - Greedy Scheme
              - Partition Scheme
              - Weighted Scheme
              - Balanced Scheme
              - Balanced-Partition Scheme
          - Limitations and Open Issues
            - Limited Scalability
            - Incomplete Design of Logical Partitioning Schemes
            - Unsupported Notification of Changes to Repository Descriptions
            - Underspecified Interactions between Service Providers and Service Discovery Entities
            - Insufficient Specification of Relationship between Service Description and Eventable Variables
            - Failure to Consider Resource Constraints in Devices
          - Variable Discovery and Monitoring
          - Performance Considerations
            - Probabilistic Response
              - Random Response Strategy
              - Timed Response Strategy
            - Multicast Implosion Avoidance
              - Timed Response
    - Service Discovery
  - Data Consumers
    - Search & Retrieve
      - Download
      - Analyze Locally
      - Reporting
      - Visualization
      - Use for Their Own Processes
    - System Orchestrator
      - Business Ownership Requirements and Monitoring
      - Governance Requirements and Monitoring
      - Data Science Requirements and Monitoring
      - System Architecture Requirements and Monitoring
      - Application Providers
        - Data Collection Processes
        - Data Curation Processes
        - Data Analytics Processes
        - Visualization
        - Access
      - Framework Providers
        - Infrastructures
        - Platforms
        - Processing Frameworks
      - System Management
        - Provisioning
        - Configuration
        - Package Management
        - Software Management
        - Backup Management
        - Capability Management
        - Resource Management
        - Data Management
        - Performance Management
        - Security & Policy Management
      - Security and Privacy
        - Policy Requirements
        - Monitoring
      - Data Scrubbing
        - For Personally Identifiable Information (PII)
        - For Randomization (For Implicit PII)
  - Data Providers
    - Data Capture from Sources
    - Data Persistence
    - Data Annotation / Metadata Creation
    - Access Right Management
    - Access Policy Contracts
    - Data Distribution APIs
    - Capabilities Hosting
    - Data Availability Publication
  - Deployment Models
    - Private
    - Community
    - Public
    - Hybrid
  - Characteristics
    - Self-Service
    - Broad Network Access
    - Pooled Resources
    - Elastic
    - Metered/Measurable
    - Interoperable
  - Service Models
    - SaaS
    - PaaS
    - IaaS
  - Cloud Computing
  - Big Data
- Distributed Systems
  - Synchronization
    - Distributed Transactions
      - Models
      - Concurrency Control
      - Mutual Exclusion
      - Election Algorithms
      - Global State
    - Clocks
      - Physical
      - Logical
    - Services/Entities
      - Naming
      - Locating
      - Garbage Collection / State Reference Removal
    - Code Migration
- Databases
  - Theory
    - Data Exchange
    - Data Provenance
    - Data Modeling
    - Database Query Languages (Principles)
    - Database Constraints Theory
    - Database Interoperability
    - Data Structures and Algorithms for Data Management
    - Database Query Processing and Optimization (Theory)
    - Data Integration
    - Logic and Databases

Privacy
- Data Fusion
  - Kalman Filtering
  - Particle Filtering
  - Graphical Models
  - Distributed Inference
- Data Services
  - Storage
    - Archiving
    - Transformation
    - Indexing
    - Data Aging
    - Query Interface
    - Visualization
    - Tools and Libraries
  - Distributed Signal Processing
    - Sampling and Data Collection
    - Compression
    - Detection
    - Classification
    - Localization
    - Tracking
    - Array Signal Processing
    - Beamforming
    - Direction of Arrival Estimation
- Data Analytics
  - Collaborative Infomation Processing
    - Sensor Tasking and Control
      - Information Utility and Cost Functions
      - In-Network Aggregation
      - Multi-Scale Summarization
      - Query Optimization and Processing
    - Sensor Group Management
      - Cluster and Leader Election Protocols
      - Distributed Routing
      - Fault Tolerance

Unique Identification
- "Things" Needing Identification
  - Objects
    - Physical Objects
    - Network Elements (Cyber Objects)
    - Software/Content/Data (Virtual Objects)
  - Events
  - Persons
    - Real
    - Legal
  - Locations of "Things" and Events
    - Global Coordinate System
    - Local Coordinate System
    - Relative Coordinate System
    - Civic Coordinate System
    - Database Reference System (e.g., DUNS, ZIP, GLN)
    - Internet Address (e.g., DNS, URL, IP Address)
  - Time Instance of Occurrence of Events
    - Global Time (e.g., UTC)
    - Local Time
    - Linear Bar Code Symbols
    - 2D Symbols
      - Optically Readable Media
      - OCR
  - RFID
    - UHF
      - 433 MHz
      - 860 - 960 MHz
      - 2450 MHz
    - HF
      - 13.56 MHz (ISO/IEC 18000-3)
      - 13.56 MHz (NFC)
      - 13.56 MHz (Smart Card)
    - LF
- Technologies/Media
  - Database Reference for Persons
  - Biometrics and Identity Management
    - Biometrics Modalities
      - Friction Ridge
      - Finger
        - Finger Geometry
        - Finger Skeleton
      - Face
      - Eye
        - Iris
        - Retina
      - Hand Geometry
      - Palm
      - DNA
      - Voice
      - Vein Pattern
      - Keystroke
      - Gait
      - Ear Shape
      - Dynamic Signature
    - System Components
      - Data Capture
      - Data Storage
      - Signal and Image Processing
        - Enhancement and Segmentation
        - Feature Extraction
        - Quality Assessment
      - Comparison
      - Decision
      - Administration
      - Interfaces
      - Enrollment
      - Recognition
        - Verification
        - Identification
      - Functions
        - Quality
        - Liveness
        - Template Protection
      - Processing
        - Symbol Reader
        - RFID Reader
        - IC Card Reader
  - Interface Devices
    - Fixed Position Devices
    - Mobile Devices
      - Mobile Phones
        - IC Card Interface
        - Symbol Interface
        - RFID Interface
      - Handheld Symbol Reader
      - Handheld RFID Reader
      - Localization and Tracking Devices

Energy Consumption
- At Data Centers and in the Cloud
  - Need to be low power in order to last for a long time.
  - Smart battery discharge schedule can lead to natural recharging and longer battery life.
  - Sensing Schedule
    - On a Continuous Basis
    - Periodic On/Off
    - Event-Based (Use a lower power, less precise sensor to detect an event of interest and wake up the higher precision sensor.)
  - Data Processing Techniques, e.g. Clustering Algorithms and Data Aggregation
  - Radio Power Consumption Modes
    - Off
    - Tx
    - Rx
    - Standby
    - Circuitry Start-Up
    - Switching Cost (If possible, transmit for many time slots and then receive for many time slots.)
- Energy Efficiency
  - Energy Efficiency at Various Layers of OSI Protocol Stack
    - Reducing energy consumption at one layer may result in increased energy consumption at another.
    - If possible, use cross-layer design (e.g., by setting Tx power, ARQ/FEC, scheduling, and routing (in case of ad hoc networks) together and preferably using a distributed algorithm) to achieve optimum tradeoff between QoS and energy efficiency.
    - Be mindful of packet header overhead (long vs. short packets).
    - PHY Layer
      - Energy-Efficient Coding arf Modulation Schemes
      - Channel Equalization
    - Data Link Layer
      - Take channel conditions into account. No sense in transmitting when the channel conditions are poor.
      - Reduce chances of packet collisions, because they may lead to retransmissions, which consume more energy.
      - One may schedule transmissions and receptions, e.g. to avoid receiving a packet that does not belong to you. The cost is the need to compute the schedule and communicate it to all.
      - Whenever possible, schedules should be computed by base stations.
      - Scheduling algorithm may consider remaining battery energy of a node in addition to connection priority.
      - Mobile device can rearrange time slots allocated to it among its flows.
      - Mobile device should request for multiple time slots in one reservation request.
      - Keep radio in standby mode or even let it go to sleep when not needed.
      - Take advantage of the broadcast nature of wireless transmissions for broadcast/multicast traffic.
      - Combined FEC/ARQ for Energy Conservation
      - ARQ Probing Method as a Means for Energy Conservation
    - Network Layer
      - In ad hoc networks, the routing protocol should not simply minimize energy consumption, but it should maximize network lifetime.
      - Ensure all nodes run out of battery energy at roughly the same time.
      - Avoid routing through nodes with low battery energy.
      - Select frequency of routing table updates judiciously.
      - What route to use depends also on the nature of traffic (unicast/broadcast/multicast).
      - Use transmit power as a means for topology control.
      - It is important to distinguish between network congestion and loss due to wireless links (deep fades, handoff).
    - Transport Layer
      - Protocols to Mitigate TCP Problems over Wireless Links
        - Split Connection
        - Link-Layer
        - End-to-End
    - Application Layer
      - Load Partitioning Between Mobile and Base Station
      - Cloud Computing
      - Proxies – Middleware that adapts applications to changes in battery energy and bandwidth.
      - Energy-Efficient Query Optimization in Database Systems
      - Power-Aware Video Processing
  - Operating System (OS) Level Energy Efficiency
    - Dynamically control power consumption by varying supply voltage. This affects CPU operating speed, but techniques such as pipelining and parallelism can be used to increase processing speed.
    - Suspend operation of disk, memory, or display when prolonged inactivity is detected.
    - Predictive Shutdown of CPU / Power-Aware CPU Scheduling
    - Memory Page Allocation
    - Appropriate Performance Metric: Energy-Delay Product
- At Mobile Devices and Wireless Sensor Nodes

Networking
- Transmission Medium
  - Wired
    - Cables
    - Optical Fiber
    - Power Line Communications (PLC)
  - Wireless
    - Radio Frequency (RF)
      - Network Variety
        - Cellular Telephony (3G/4G Wireless)
        - Wireless Local Area Networks (WLAN)
        - Wireless Personal Area Networks (WPAN)
        - Satellite Communications (SATCOM)
      - Spectrum Allocation
        - Licensed
        - Unlicensed
        - Opportunistic Spectrum Access (OSA) / Cognitive Radio (CR)
    - Infrared
    - Free Space Optical
- Communication Protocols
  - OSI Protocol Stack
    - Physical Layer
      - Modulation
      - Coding
      - Channel Equalization
    - Data Link Layer
      - Medium Access Control (MAC)
      - Logical Link Control
    - Network Layer
      - IPv4
      - IPv6
      - X.25
    - Transport Layer
      - Transmission Control Protocol (TCP)
      - User Datagram Protocol (UDP)
    - Session Layer
    - Presentation Layer
    - Application Layer
      - Session Initiation Protocol (SIP)
      - Real-Time Transport Protocol (RTP)
  - Other Protocol Stacks
- Quality of Service (QoS)
- Widely-Used Standards
  - Wired
  - Wireless
- Topology
  - Point-to-Point
  - Bus
  - Star
  - Ring
  - Daisy Chain
  - Mesh
  - Tree
  - Ad Hoc

Situation-/Context-Awareness
- Sensors
  - Motion
    - Accelerometer
    - Gyroscope
  - Magnetometer
  - Environmental
    - Temperature
    - Humidity
    - Barometric Pressure
    - Wind Speed
    - Seismic
    - Light/Photometer
    - Gravimeter
  - Acoustic
    - Audio
    - Sound
    - Ultrasound
  - Still/Video Imagery
    - Photographic
    - Infrared
    - Biologic
    - Light Detection and Ranging (LIDAR)
    - Range Finder
  - Global Navigation Satellite System (GNSS)
    - Global Positioning System (GPS)
    - Globalnaya Navigatsionnaya Sputnikovaya Sistema (GLONASS)
    - Galileo
- Types of Context
  - Computing Context
    - Network Connectivity
    - Communications Cost/Bandwidth
    - Nearby Resources
  - Human User Context
    - User Profile
    - Social Situation
    - Human Activity
  - Device/Service State
    - On
    - Off
    - Dormant/Listening
    - Paging/Polling
  - IoT Device Context
    - Personal Device
      - Display
        - Size
        - Resolution
        - Dynamic Range
        - Refresh/Frame Rate
      - Sound
      - Sensor Specifications
      - Actuator Specifications
  - Physical Context
    - Lighting
    - Background Noise
    - Traffic Conditions
    - Weather Conditions (Temperature/Humidity/Rain/Snow)
    - Presence of People and Animals
    - Environmental Hazards
      - Air Quality
      - Gaseous Conditions
      - Dust/Particulates
  - Location Context
    - Semantic (Home, Office, Theatre, Hospital, Airport, etc)
    - 3D Global Coordinates
  - Time Context
    - Time of the Day
    - Day of the Week
    - Month/Season
    - Year
- Control Actions in Response to Context
- Personal Experience
- Accessibility Support
  - Matching to Context
  - Content Guidelines
  - Product Design Requirements and Guidelines
  - Roles and Permissions
  - Assistive Technologies
  - Adaptive Devices
  - Personal Needs, Preferences, and Requirements
    - General
    - Sector-Specific
- Operating Environment
  - Outdoor
    - GPS/GNSS
    - Star Tracker
  - Both
    - Inertial Navigation System (INS)
    - Tower-Based (Cellular Telephony)
    - Still/Motion Imagery
    - Signals of Opportunity (e.g. TV and Radio Stations)
  - Indoor
    - RF-Based
      - Received Signal Strength (RSS) Based
      - Proximity-Based (e.g. RFID-Based)
      - Time of Arrival (TOA) / Time Difference of Arrival (TDOA)
      - Angle of Arrival
    - Range/Pseudo-Range Finder
    - Altimeter
    - Acoustic Sensor
    - Ultrasound Sensor
- Sensor Types Used
  - Unimodal Systems
  - Multimodal/Hybrid Systems

Localization and Tracking

Modeling
- Linear Systems
  - [no text]
  - Time Domain
  - Frequency Domain
  - Polynomial and Matrix Fraction Descriptions
- Nonlinear Systems
  - Discrete Time
  - Continuous Time
  - Variable Structure
- Distributed Parameter Systems
  - Hyperbolic Systems
  - Parabolic Systems
  - Linear Systems
  - Nonlinear Systems
- Stochastic Systems
  - Discrete Time Markov Processes
  - Finite State Markov Chains
  - Discrete Event Systems, Petri Nets
  - Stochastic Differential Equations
  - Linear Gaussian Systems
  - Nonlinear Systems
- Networked Systems
  - Graphs and Neighborhoods
  - Multi-Agent Systems
  - Communication Networks
  - Mobile Ad Hoc Networks
- Hybrid and Switching Systems
  - Dynamical Systems
  - Event-Triggered Systems
  - Self-Triggered Systems
- Games
  - Cooperative Games
  - Non-Cooperative Games
  - Static Games
  - Dynamic Games
  - Stochastic Games

Controls
- Optimal Control
  - Calculus of Variations
  - Dynamic Programming
  - Maximum Principle
  - Linear Quadratic Regulator Control
  - Discrete- and Continuous-Time Riccati Equations
  - H-infinity Optimal Control
  - Linear Matrix Inequalities
  - Quantitative Feedback Theory (QFT)
  - Spectral Factorization
- Estimation and Filtering
  - Least Squares Estimation
  - Wiener Filtering
  - Kalman Filtering
  - Extended Kalman Filter
  - Nonlinear Filters
  - Particle Filters
- Identification
  - Non-Parametric Techniques
  - Frequency Domain Methods
  - Time Domain Methods
  - Subspace Techniques
  - Covesification, Regularization, and Relaxation
- Stability
  - Lyapunov Stability
  - Input-Output Stability
  - Input-to-State Stability
- Stochastic Control
  - Linear-Quadratic-Gaussian Control
  - Separation and Certainty Equivalence
  - Dynamic Programming and HJB Equation
  - Stochastic Maximum Principle
  - Stability of Stochastic Systems
  - Risk-Sensitive Stochastic Control
  - Supervisory Control of Discrete Event Systems
  - Perturbation Analysis of Discrete Event Systems
- Nonlinear Control
  - Zero Dynamics
  - Output Regulation
  - Feedback Linearization
  - Differential Geometric Methods
  - Lie-Algebraic Methods
  - Controllability and Observability
  - Observer Design
  - Time-Scale Separation and Singularly Purturbed Systems
  - Control of Non-Holonomic and Underactuated Systems
  - Variable Structure & Sliding Mode Control Design
  - Control of Chaotic Motion
  - Hybrid Observers
  - Hybrid Feedback Control
- Decentralized and Distributed Control
  - Decoupling by Decentralized Feedback
  - Control of Networked and Multi-Agent Systems
  - Passivity for Network Stability and Distributed Control
  - Distributed Optimization
  - Intelligent Control
  - Averaging Algorithms and Consensus
  - Team Solutions Under Decentralized Information
  - Non-Classical Information Patterns
  - Flow Control Over Communication Networks
  - Control Over Digital Networks
- Quantized, Digital Control
  - Design Under Data Rate Constraints
  - Sampled Data Control
  - Optimum Quantization
  - Performance Limitations
  - Control Over Lossy Networks
  - Symbolic Control
- Control of Distributed Parameter Systems
  - Control of Heat Equations
  - Control and Stabilization of Fluid Flows
  - Control of Schroedinger Systems
  - Boundary Control of PDEs via Backstepping
  - Control of Systems with Delays
- Adaptive Control and Learning
  - Model Reference Adaptive Control
  - Self-Tuning Regualtor
  - Switching Adaptive Control
  - Robust Adaptive Control
  - Stochastic Adaptive Control
  - Extremum Seeking
  - Iterative Learning
- Robust Control
  - Kalman-Yakubovich-Popov Lemma
  - Fundamental Limitations
  - Gap Metric
  - Structured Singular Values
  - H-infinity Control
  - Robust Servomechanism Design
  - Robustness with Real Parametric Uncertainty
  - Multivariable Poles, Zeros, and Pole-Zero Cancellation
  - Stability Robustness to Unstructured Uncertainty
  - Balanced Realizations and Model Order Reduction
  - Fault Tolerant Control
- Model-Predictive Control (MPC)
  - Moving Horizon Estimation and Control
  - Distributed MPC
  - Explicit MPC
  - Robust MPC
- Game Theory
  - Auction Theory
  - Mechanism Design
  - Nash Equilibrium
  - Hierarchical (Stackleberg) Equilibrium
  - Evolutionary Stable Equilibrium
  - Correlated Equilibrium
  - Sub-Game Perfect Policies
  - Mean Field Games
- Computational Algorithms
  - Gradient Methods
  - Conjugate Gradient Methods
  - LMI Methods
  - Approximate Dynamic Programming
  - Neuro-Dynamic Programming
  - Neutral-Net Based Approximations

Applications
- Methodologies
- Automotive
  - Cruise Control
  - Engine Control
  - Electric and Hybrid-Electric Vehicles
  - Powertrain Control
  - Transmission Control
  - Vehicle Dynamics Control
  - Automated Highway Control
  - Aircraft Flight Control
- Aerospace
  - Air Traffic Management (ATM)
  - Satellite Control
  - Control of UAVs
  - Launch Vehicle Control
- Industrial
  - Process Control in Semiconductor Manufacturing
  - Statistical Process Control for Discrete Manufacturing
  - Control of Machine Tools and Machining Processes
  - Control of Polymerization Processes
  - Control of Porous Thin Film Growth
  - Scheduling of Batch Plants
  - MPC for Batch Processes
  - Programmable Logic Controllers
  - Flat Strip Metal Processing
  - Control of Micro and Nano Structures
  - PID Control
  - Color Control in Printing as a Feedback System
- Robotics
  - Flexible Robots
  - Parallel Robots
  - Underactuated Robots
  - Walking Robots
  - Robot Force Control
  - Robot Grasp Control
  - Robot Motion Control
  - Robot Teleoperation
  - Robotic Surgery
- Power and Electric Energy Systems
  - Control of Brushless DC Motors
  - Hybrid MPC of the Boost Converter
  - Active Power Control of Wind Power Plants
  - Control of Distributed Energy Resources
  - MPC for Power Networks
  - Power System Voltage Stability and Control
  - Singular Perturbations and Coherency in Power Grid Dynamics
  - Electric Energy Transfer and Control
  - Fast Detection and Localization of Power Grid Blackouts
  - Demand Response Management
- Biological and Medical
  - Control of Biotechnological Processes
  - Model-Based Control of Biochemical Reactors
  - Drug Discovery and Delivery
  - Biochemical Networks
  - Synthetic Biology
- Marine and Submarine Vessels
  - Control of Networks of Underwater Vehicles
  - Dynamic Positining Control Systems for Ships and AUVs
  - Undercactuated Marine Control Systems
  - Motion Planning for Marine Control Systems
  - Control of Ship Roll Motion
  - Collision Avoidance for Maritime Traffic
  - Control for Deep Underwater Sampling
- Economics and Finance
  - Stochastic Control for Construction of Portfolios of Financial Assets
  - Modeling of Consumer Investment
  - Modeling of Financial Markets
  - Optimal Inventory Theory
  - Option Theory
  - Cash Management

Actuators
- Hydraulic
- Pneumatic
- Electric
- Mechanical
- Piezoelectric
- ElectroActive Polymers (EAP)

Energy Harvesting
- Environmental Energy Sources
  - Solar Cells
  - Wind Turbines
  - Piezoelectric
  - Biochemical
  - Vibrations
  - Motion-Based
- Energy Source Classification
  - Uncontrollable but predictable, e.g. solar energy
  - Uncontrollable and unpredictable, e.g. vibrations
  - Fully controllable, e.g. self-powered flashlights that can be operated by continuously squeezing a hand lever
  - Partially controllable, e.g. when RFID tags get the necessary RF energy from an RFID reader
- Spatiotemporal Model for Variability of Harvested Power (e.g. a Solar Cell)
- Methods for Learning the Spatiotemporal Variability of Harvested Power
- Power Consumption Model for Network Node (e.g. a Sensor Node) Powered by Energy Harvesting
- The operational load in a distributed network may be redistributed among network nodes to match the spatiotemporal profile of available harvested power to maximize network lifetime.
- Power Management Algorithms
  - Energy Harvesting as a Supplement to Battery Energy: Maximize the lifetime of the network node while meeting its functional requirements.
  - Obtain the best possible performance from the network node that can be supported with the available harvested energy.
- Energy Storage
  - Devices
    - Rechargeable Batteries, e.g. Li-Ion, NiCd, NiMH
    - Ultracapacitors
  - Modes of Usage
    - Energy Neutral Systems (Relying on Energy Harvesting Only)
      - Either mode may use a device for buffering/storing energy.
      - May have to settle for lower performance for the network node than otherwise could be achieved if energy consumption was not an issue.
      - The network node can potentially function forever.
    - Dynamic Duty Cycling
    - Dynamic Voltage Scaling
- Performance-Limiting Factors
  - Inefficiency: Energy stored is always less than the energy supplied.
  - Leakage
  - Required charging current and/or voltage is high for certain batteries.
  - Battery storage capacity degrades with multiple charge-discharge cycles.