CENTER FOR
DIGITAL SAFETY & SECURITY

AUSTRIAN INSTITUTE OF TECHNOLOGY

WIRELESS M2M COMMUNICATION AND 5G & BROADBAND TECHNOLOGIES

5G wireless communication links will become a fundamental aspect for connected autonomous vehicles, Industry 4.0 production environments and for indoor localization.

Wireless communication links between machines demand fundamentally new communication system properties such as low-latency, defined error probability, an interface to control algorithms and the ability to operate in challenging environments.

These properties facilitate application in new markets, e.g. connected autonomous vehicles can exchange redundant sensor information (radar, optical, etc.) or industrial production systems gain more flexibility by replacing cable connections with wireless links. On a European level, ultra-reliable wireless machine-to-machine communications is a central research focus for 5G systems in the Horizon 2020 framework of the European commission.

OUR SOLUTIONS AND SERVICES

- Wireless channel measurements, characterization and real-time emulation
- Ulra-reliable low-latency wireless communications
- Indoor wireless positioning systems
- Real-time software defined radio algorithms

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WIRELESS CHANNEL MEASUREMENTS, CHARACTERIZATION & REAL-TIME EMULATION

Radio communication between vehicles in intelligent traffic systems and connected automated vehicles allows the avoidance of accidents by exchanging position, speed, direction of travel and other sensor data. The verification of the radio systems and vehicle control units is cost-intensive, time-consuming and difficult to repeat. For this reason, AIT is developing a real-time emulation of the vehicular radio channel, based on a geometry based stochastic model that correctly emulate the non-stationary fading process of the vehicular radio channel.

The vehicle-to-X (V2X) communication channel is subject to a non-stationary time- and frequency selective fading process, i.e. the received field strength varies over time leading to varying frame error rates. The fading process is determined by the environment of the communication link and the position of the transmitter and receiver. For the repeatable test of connected autonomous driving algorithms, we will model the environment with low-complexity geometry based stochastic models. This allows for capturing the non-stationary fading conditions at road intersections represented by Delay- and Doppler dispersion as well as strong attenuation caused by larger object such as trucks or trains.

ULTRA-RELIABLE LOW-LATENCY WIRELESS COMMUNICATIONS

The exchange of cable connections with ultra-reliable wireless communication links will improve the reconfigurability of future production lines and enables new production processes. AIT investigates and prototypes low-latency wireless communication systems to link sensors, actuators and processing units. To achieve high transmission reliability, we exploit all diversity sources in industrial scenarios enabling low-latency wireless data transmission for dynamically reconfigurable production systems.

INDOOR WIRELESS POSITIONING

We investigate and design accurate radio signal predictions tools using ray-tracing and propagation graphs. These prediction methods allow for advanced indoor localization solutions in a GPS denied environments (tunnels, office buildings, shopping malls). The AIT has know-how for beacon based Bluetooth low energy hardware infrastructures, as well as ultra-wideband and multi-antenna systems for high accuracy applications. We offer an advanced wave propagation computation engine based on geometrical building data that can be customized for various application scenarios.

REAL-TIME SOFTWARE DEFINED RADIO ALGORITHMS

Future 5G wireless communication systems target a peak data rate of 10GBit/s with a latency of 1ms, enabling wireless communication links for connected autonomous vehicles or flexible production environments. 5G massive multiple-input and multiple-output (MIMO) systems with new non-orthogonal waveforms demand new signal processing algorithms to reduce both, computational complexity and energy requirements. We investigate and prototype novel approaches based on big data algorithms for high speed processing on field programmable gate arrays (FPGA).

5G & BROADBAND TECHNOLOGIES - MASSIVE MIMO

Reliable wireless communication links are a pre-requisite for connected autonomous vehicles enabling cooperation and connecting vehicles to a mobile-edge cloud computing center at the base-station location. We investigate the basic concept of massive multiple-input multiple-output (MIMO) systems where the base station is equipped with 30...100 antenna elements while the mobile station uses a single antenna. This setup allows to focus the transmit energy of the base station by coherent superposition at the location of the mobile station removing the impairments of the fading process.

5G & BROADBAND TECHNOLOGIES - mmWAVE

For broadband communication links in 5G system new spectrum bands are needed. At AIT we are investigating novel radio system above 28GHz in the mmWave band for establishing broadband communication links in outdoor environments between base station and vehicles. Combining mmWave with beamforming and optically fed remote passive radio heads will provide the basic architecture of future 5G networks.

FURTHER INFORMATION

For further information please visit our website:
https://www.ait.ac.at/wireless/