Mikhail Ivanov, PhD

Senior Systems Engineer

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Summary

Mikhail is a communications engineer with 9 years of experience in the area of digital communications and signal processing. His main focus is on the physical layer and the medium access control layer. He has been involved in the receiver design for modern communications systems, including 3G and 4G, as well as waveform comparison for 5G as part of the MmMagic project. He has also been involved in projects regarding radars, where he has designed detection algorithms. He is a professional user of Matlab and C/C++. His practical experience together with a solid analytical background obtained during his PhD studies allows him to efficiently solve complex engineering problems.

Expertise

Industries / business sectors

- Telecommunications
- Automotive

Tools

- C, C++, IT++
- Matlab, Simulink, Matlab Coder
- Eclipse, MS Visual Studio
- MS Office
- Latex
- Windows, Linux

Competencies

- Signal processing
- Channel coding
- Modulation
- Information theory
- Probabilistic graphical models
- Radar

Selected Assignments

2016, Obstacle Detector, Qamcom Research&Technology

In the developed obstacle detector, two different detectors can be used. The first one is able to detect one target for a given range and Doppler shift and is referred to as the binary detector. To detect multiple targets at the same range with the same Doppler shift, the so-called sequential detector has been designed, where the hypotheses with different numbers of targets are sequentially tested against each other. I have been involved in the analysis of the statistics for the hypothesis testing, setting up the parameters of the sequential detector, and evaluating its performance.

The work included:

- Evaluation of the binary detector
- Comparison of the binary detector and the sequential detector
- Parameter tuning of the sequential detector

Tools used:

- Matlab

2016, Radar on a Moving Platform, Qamcom Research&Technology

In this project, I have been designing signal processing algorithms for detecting multiple targets for a radar installed on a moving platform. It involved calibration of the radar, processing the radar data to obtain detections, and further tracking of the detections.

The work included:

- Calibration
- Algorithm design
- Matlab (and Matlab coder) code development
- Measurements and validation
- Performance analysis
- Documentation

Tools used:

- Matlab
- Maltab Coder
- Radar
- Test equipment

2016, Waveform Comparison for 5G, Qamcom Research&Technology

In this project, I was comparing multiple-carrier waveforms that are considered for the 5G standard in the MmMagic project. The waveforms included orthogonal frequency-division multiplexing (OFDM) with the cyclic prefix and the unique codeword, the filter bank multicarrier (FBMC) with quadrature amplitude modulation (QAM), as well as offset QAM. For OFDM, multiple-input multiple-output (MIMO) with hybrid beamforming was implemented.

The work included:

- Beamforming algorithm design
- Performance evaluation for the QuaDRiGa channel model

- Matlab code development

Tools used:

- Matlab
- QuaDRiGa

2013-2016, Medium Access Control Protocols for Vehicular Networks, Chalmers University of Technology

In this project, I was designing an uncoordinated medium access control (MAC) protocol for vehicular networks, which meets stringent reliability and delay requirements of vehicular communications. The designed protocol is based on slotted ALOHA and exploits successive interference cancellation at the receiver. The designed protocol is compared with carrier sense multiple access, which is currently adopted as a MAC protocol in the 802.11p standard.

The project included:

- Protocol design.
- Theoretical analysis.
- MATLAB and C++ code development.
- Documentation.

The tools employed:

- C++.
- MATLAB.

2011-2013, Analysis of Bit-Wise Decoders for Coded Modulation, Chalmers University of Technology

Different decoding algorithms for coded modulation are compared and analyzed in this project. In particular, I analyzed the performance of a bit-wise decoder, which is usually used in bit-interleaved coded modulation schemes. I compared it with the optimum maximum likelihood decoder and obtained theoretical bounds on the performance loss in terms of the signal-to-noise ratio.

The project included:

- Theoretical analysis.
- MATLAB and C++ (IT++) code development.
- Documentation.

The tools employed:

- MATLAB.
- C++, IT++.

2010: Phase and Timing Synchronization for MSK Signals, St. Petersburg State Electrotechnical University

In this project, closed-loop phase and timing synchronization algorithms for minimum shift keying (MSK) signals were implemented. The algorithms were designed to tolerate large carrier frequency offsets due to the carrier frequency instability. The final result was a Simulink block that performed matched filtering, synchronization, and interpolation.

The project included:

- MATLAB, Simulink, and C++ code development.
- Documentation.

The tools employed:

- C++.
- MATLAB.
- Simulink.

2010: Analysis of Signals of Various Wireless Communications Systems, St. Petersburg State Electrotechnical University

A software that analyzes signals of common wireless communications systems was designed. The considered wireless systems include GSM, UMTS, DECT, Wi-Fi, and Bluetooth. The software performs frequency and timing synchronizations, determines the modulation format, performs demodulation, and attempts to extract information from preambles and headers, as specified in the standards.

The project included:

- MATLAB and C++ code development.
- Documentation.

The tools employed:

- C++
- MATLAB.

2007: Noncoherent Receiver for CPFSK Signals, St. Petersburg State Electrotechnical University

In this project, a noncoherent receiver for continuous phase frequency shift keying (CPFSK) signals based on the Viterbi decoder was developed. Gaussian minimum shift keying (GMSK) belongs to the family of CPFSK signals and is used in GSM. In the second stage of the project, a receiver insensitive to carrier frequency offsets was developed and analyzed.

The project included:

- Algorithm development.
- Theoretical performance analysis.
- MATLAB code development.
- Documentation

The tools employed:

- MATLAB.

Education

2011 - 2016 PhD in Electrical Engineering, Chalmers University of Technology, Gothenburg, Sweden
2007 - 2009 MSc in Engineering and Technologies, St. Petersburg State Electrotechnical University "LETI", St. Petersburg, Russia

Employers

2016 - present Senior System Engineer, Qamcom Research&Technology
2011 - 2016 PhD student, Chalmers University of Technology, Gothenburg, Sweden
2007 - 2011 Engineer, Research Laboratory of Radio Systems and Signal Processing, St. Petersburg State Electrotechnical University "LETI", St. Petersburg, Russia

Selected Publications

M. Ivanov, F. Brännström, A. Graell i Amat, and P. Popovski, "Broadcast Coded Slotted ALOHA for Vehicular Communications: A Finite Frame Length Analysis," submitted to IEEE Transactions on Communications.
M. Ivanov, F. Brännström, A. Graell i Amat, and G. Liva, "Unequal Error Protection in Coded Slotted ALOHA," IEEE Wir. Commun. Lett., to appear.
M. Ivanov, C. Häger, F. Brännström, A. Graell i Amat, A. Alvarado, and E. Agrell, "On the Information Loss of the Max-Log Approximation in BICM Systems," IEEE Trans. Inf. Theory, vol. 62, no. 6, pp. 3011–3025, June 2016.