

# Ilya Korogodin

## Curriculum Vitae

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Engineer, researcher, and professor solving problems and enjoying the solutions.

## Previous Employment

2013–  
nowadays **Associate Professor, Head Researcher, Moscow Power Engineering Institute.**

As professor, I teach professional and postgraduate courses (Navigation Receivers, Systems Simulation) and supervise postgraduate students.

- As researcher and engineer, I conduct R&D in the field of navigation systems: spoofing, CRPA, GLONASS satellites equipment, GLONASS CORS, assisted navigation, indoor navigation. I am a principal developer of a FPGA-based navigation receiver/simulator/spoofing core, a head developer of two ASICs. I recruit the team and teach them. I am responsible for interactions with customers, technical documentation, and reports.

2010–2013 **Teaching Assistant, Moscow Power Engineering Institute.**

As assistant, I taught a professional Basics of GNSS course, was participated in a Navigation Receivers course. I supervised graduate students and held the post of Scientific Secretary of the State Attestation Commission.

- I conducted R&D: navigation receiver for satellite vehicles, multipath suppression techniques, antijam properties and algorithms. I developed a firmware for an ASIC-based attitude determination GNSS receiver: calibration technique, tracking systems, measurements. Also, I developed a firmware for FPGA-based navigation receiver: protocols, interfaces, signal tracking, host software.

2006–2010 **Engineer, Moscow Power Engineering Institute.**

- I participated in GNSS and navigation receivers R&D: receiver properties, new GLONASS CDMA signals, integrated inertial-GNSS navigation systems. I investigated signal processing algorithms: attitude determination receivers, tracking loops, multipath, antijam capability. Matlab, estimation theory, laboratory equipment and navigation receivers were my main instruments at the time.

## Education

- 2010–2013 **PhD, Navigation and location systems, Moscow Power Engineering Institute, PhD thesis "Development of signal processing algorithms for attitude determining GNSS receivers".**
- 2008–2010 **Master's Degree, Electrical and Electronic Engineering, MPEI, All A, with honors.**
- 2004–2008 **Bachelor's Degree, Radiophysic, MPEI, Moscow, All A, with honors.**

- 1993–2004 **High School**, *Zlatoust, with honors.*

## Notable Projects

- **CoreZh: FPGA-based GNSS receiver/simulator/spoofers core**

I am the head of a team developing a FPGA-based GNSS receiver/simulator/spoofers core. The core includes developed software for the Xilinx Zynq processor system and programmable logic. It implements signal processing and other functions:

- SpaceTime Adaptive Processing
- Fast signal acquisition
- Multi-input correlation channels
- Precise time synchronization
- GNSS vector signal generator channels
- others

The CoreZh is an engine for several successful GNSS-related projects:

- **GLONASS laser continuously operating reference station (CORS)**

The main feature of the project is precise picosecond-level time synchronization. CoreZh-based GNSS receiver operates in conjunction with a laser range-meter and a hydrogen clock. GNSS signals of L1, L2, L3 bands are processed.

- **Multi-element antenna CORS**

The main feature of the project is a CRPA beamforming and RTK with the CRPA. GNSS signals of L1, L2, L3, L5 bands are processed.

- **GNSS Simulator/Spoofers**

It is a precise GNSS synchronized simulator of GNSS navigation signals. It implements imperceptible spoofing of the signals.

I was the principal software developer and system architect of the projects.

- **STAP ASIC**

It was ASIC for space-time adaptive signal processing for CRPAs and locators. The project was successful, the ASIC works fine. I participated in architecture developing process, wrote about 50% of final HDL code. It was a challenging to optimize the code by power consumption and chip area. Also, I developed a bit-accurate Matlab model to verify the HDL code.

- **SV Navigation Receiver ASIC**

It was ASIC for navigation signal processing. The chip was intended for space vehicles. I participated in the architecture developing process and wrote some final HDL code and matlab models.

- **CDMA signals for GLONASS**

It was part of a team developed new CDMA GLONASS signals (L1OC, L1SC, L2OC, L2SC). I carried out calculations and simulations for the considered variants: thermal noise errors, multipath mitigation, intrasystem interference and so on.

- **GNSS receiver for attitude determination**

I participated in developing of a GLONASS multi-antenna receiver. It determines user attitude by means of navigation signals phases comparison. It was challenging to solve calibration problems for FDMA signals. I have developed special calibration technique and on-the-go algorithm based on the antennas swithing. Also I have developed a difference phase locking loops (DPLL). The algorithm dramatically increased accuracy and antijam capability of the attitude determinations.

- **Bayes estimator**

I implemented a strict Bayes estimator in Matlab and researched potential accuracy for frequency and difference phase estimations. This was a complete immersion in the theory of estimation.

- **Integrated GNSS-Inertial navigation system**

I participated in the system development process, wrote some code. The project introduced me to INS, huge Kalman filters and computational problems of inertial navigation.

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## Technical and Personal skills

- **Programming Languages:** Proficient in: C, C++, Matlab, Verilog, SystemVerilog, TeX.  
Also basic ability with: Python, Java, R, TCL, PHP, bash.
- **Industry Software Skills:** gcc, gdb, Matlab, Vivado, ISE, SolidWorks, AutoCAD, MS Office, git.
- **Laboratory Equipment Skills:** Rohde & Schwarz SMBV/SMJ, FSV/FSU, ZVA/ZVH and others; Spirent GNSS Simulators; Ettus USRP; Javad, Trimble, NVS, Geostar, u-blox and other GNSS receivers and chips.
- **General Business Skills:** Problem solving, presentation skills, works with customers, team leading, mentorship, organization of R&D.
- **Languages:** Russian (Native), English (B1/B2).

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## Awards and Honors

- PIERS-Rome Young Scientist Award, 2019
- Tsiolkovsky Award of Cosmonautics Federation of Russia, 2018
- PIERS-Toyama Young Scientist Award, 2018
- MPEI Young Teaching Fellow of the Year, 2014
- Scholarship of the Government of the Russian Federation, 2011
- Scholarship of the President of the Russian Federation, 2009

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## Interests and extra-curricular activity

- I am interested in interior design and architecture. I have designed and built my own house in the Moscow suburbs. I have developed and realised a design-project of our university office.
- I am a member of the administrative reserve of our university. I graduated trainings and have the title of Manager In Education.
- I am a DevOps for our small team: gitlab, wiki, Apache, redmine and so on.

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## Intellectual property

- The full list of publications contains about 25-30 items and is available on request
- I'm a co-author of a book (a thousand of terrific pages in Russian))
- I'm an author of 4 Russian patents, 6 registered software products

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## Publications

A. I. Perov, R. V. Bakitko, V. V. Dvorkin, S. N. Karutin, I. V. Korogodin, I. A. Nagin, A. A. Povalyaev, R. F. Fatkylin, and A. U. Shatilov, *GLONASS. Modernization and development perspective*, A. I. Perov, Ed. Izdatel'stvo Radiotekhnika, 2020.

O. K. Mikhaylova, I. V. Korogodin, and I. V. Lipa, "Universal ranging code generator of glonass and gps open navigation signals," in *2020 International Youth Conference on Radio Electronics, Electrical and Power Engineering (REEPE)*, 2020, pp. 1–5. [Online]. Available: <https://ieeexplore.ieee.org/document/9059133>

I. V. Korogodin, S. P. Ippolitov, and I. V. Lipa, "Adaptive beamforming algorithm in real numbers arithmetic," in *2019 Progress in Electromagnetics Research Symposium (PIERS)*, 2019.

I. V. Korogodin, V. V. Dneprov, and O. K. Mikhaylova, "Triangulation positioning by means of wi-fi signals in indoor conditions," in *2019 Progress in Electromagnetics Research Symposium (PIERS)*, 2019.

- O. K. Mikhaylova, I. V. Korogodin, and I. V. Lipa, "Universal ranging code generator for gnss," in *Radiotekhnika*, no. 9(14). Izdatel'stvo Radiotekhnika, 2019, pp. 35–41. [Online]. Available: <http://www.radiotec.ru/article/24037>
- I. V. Korogodin, "Naive beamforming for multi-element antenna gnss receiver," in *2018 Progress in Electromagnetics Research Symposium (PIERS-Toyama)*, 2018, pp. 2306–2310. [Online]. Available: <https://ieeexplore.ieee.org/document/8597615>
- , "OFDM signals utilization in navigation systems," *Radiotekhnika*, vol. 9, pp. 131–139, 2018.
- I. V. Korogodin and V. V. Dneprov, "Impact of antenna mutual coupling on WiFi positioning and angle of arrival estimation," in *Proceedings of the MWENT 2018*, 2018.
- I. V. Korogodin, "Features of OFDM signals delay tracking for navigation and radio location," in *2017 Progress in Electromagnetics Research Symposium - Fall (PIERS - FALL)*, Nov 2017, pp. 1654–1659.
- I. V. Korogodin, E. N. Boldenkov, and V. V. Dneprov, "Vehicle-to-vehicle angular determinations by means of DSRC signals," *Proceedings of the 30th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+ 2017)*, pp. 622–636, 2017. [Online]. Available: <https://www.ion.org/publications/abstract.cfm?articleID=15131>
- I. V. Korogodin and V. V. Dneprov, "Mutual angular V2V determinations with DSRC utilization," *Radiotekhnika*, vol. 11, pp. 9–21, 2017.
- V. V. Dneprov and I. V. Korogodin, "Integration of GNSS-based attitude determination algorithm with low-grade gyro," *Radiotekhnika*, vol. 9, pp. 121–127, 2016.
- I. V. Korogodin, E. N. Boldenkov *et al.*, "The results of developnig a gnss-range seven-element convex antenna array," *Internavigaciya*, vol. 9, pp. 121–127, 2016.
- I. V. Korogodin, A. I. Perov, V. V. Dneprov, and S. A. Savelyev, "Experimental study of the characteristics of the navigation receiver with antenna array and focusing on navigation satellites," *Radionavigation technology*, pp. 100–105, 2016.
- V. V. Dneprov and I. V. Korogodin, "Analysis of angular discriminator in one-stage GNSS-based attitude determination," *Radiotekhnika*, vol. 12, pp. 129–138, 2015.
- I. V. Korogodin and V. V. Dneprov, "Combined phase-frequency tracking in GNSS receivers," *Radionavigation technology*, vol. 4, pp. 16–19, 2015.
- V. V. Dneprov and I. V. Korogodin, "Combined phase-frequency tracking in GNSS receivers," *Radionavigation technology*, no. 9, pp. 106–112, 2014.
- I. V. Korogodin, "Estimation of satellite orbit parameters by means of GNSS," *Radiotekhnika*, vol. 10, pp. 98–102, 2013.
- A. I. Perov, E. V. Zaharova, I. V. Korogodin, and A. A. Perov, "Synthesis and analysis of non coherent delay tracking algorithm for pilot component L1OC GLONASS signal," *Radiotekhnika*, vol. 7, pp. 90–96, 2013.
- I. V. Korogodin, "The potential performance of frequency estimation for non-coherent receiver," *Radiotekhnika*, vol. 7, pp. 109–115, 2013.
- V. V. Dneprov and I. V. Korogodin, "Acquisition of navigation signal modulated by data," *Radiotechnical notebooks*, vol. 50, pp. 41–45, 2013.
- E. N. Boldenkov, I. V. Korogodin, and I. V. Lipa, "In-car GNSS jammers tracking system evaluation results," *Proceedings of the 25th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS 2012)*, pp. 901–906, 2012.

- I. V. Korogodin and A. M. Bukreev, "Compensation for the difference between phase shifts in the RF blocks of goniometric GLONASS receivers," *Radiotekhnika*, vol. 6, pp. 140–147, 2012.
- A. I. Perov and I. V. Korogodin, "Coherent-incoherent reception of signals in spatially separated points in condition of multipath propagation," *Radiotekhnika*, vol. 6, pp. 108–117, 2012.
- I. V. Korogodin, A. I. Perov, and A. M. Bukreev, "Compensation of the error introduced by multipath in the measurements of the phase of the radio navigation signal," *Radionavigation technology for industry*, p. 30, 2011.
- A. I. Perov and I. V. Korogodin, "Synthesis and analysis of signal processing algorithms in the equipment for determining the angular orientation of objects according to the signals of the GNSS," *Radionavigation technology for industry*, pp. 65–74, 2011.
- I. V. Korogodin, "Model of multipath propagation for signal of global navigation satellite system with reflection from the screen of finite size," *Radiotekhnika*, vol. 7, pp. 95–99, 2011.
- A. I. Perov and I. V. Korogodin, "Synthesis and analysis of algorithms for estimating the power of the signal and the noise components at the correlator's output," *Radiotekhnika*, vol. 7, pp. 76–82, 2011.
- I. V. Korogodin and A. I. Perov, "Synthesis and analysis of discriminator of phase difference of radio navigation signals received at a few space diversified points," *Radiotekhnika*, vol. 7, pp. 84–92, 2010.
- A. I. Perov, I. V. Korogodin, and O. E. Lopatko, "Combined coherent-noncoherent system for orientation angels estimation using signals of space navigation systems," *Radiotekhnika*, vol. 7, pp. 88–98, 2009.
- A. I. Perov and I. V. Korogodin, "Optimal angle of arrival estimation by two spaced receivers for signal with unknown initial phase," *Radiotechnical notebooks*, no. 37, pp. 57–61, 2008.