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Editorial

Electromagnetic Communication in Nano-scale

In order for nano-scale devices to perform complicated tasks, they can form nanonetworks consisting of several nanodevices communicating and cooperating with each other. Electromagnetic (EM) communication has been suggested as one of the possible approaches for the communication among nanodevices. Examples of the proposed EM communication approaches include communication in the very high frequency (VHF) (30–300 MHz) band with receivers using mechanically oscillating carbon nanotubes (nanotube radio) and communication in the THz band (0.1–10 THz) with receivers using e.g. graphene-based plasmonic nano antennas. This special issue is dedicated to wireless communication in the THz band, especially in nano-scale. Focus is on propagation and noise models, networking issues, and human tissue properties at THz frequencies.

After rigorous peer review with expert reviewers, 4 papers were selected for inclusion in the special issue. In the following, a brief summary of these papers is provided.

The first paper "Lightweight, Self-tuning Data Dissemination for Dense Nanonetworks" by A. Tsioliaridou, C. Liaskos, S. Ioannidis, and A. Pitsillides presents flood-based networking approach suitable for nanonetworks. Each node is only required to have 10 bits storage and capability for simple operations to enable real-time classification of nodes based on their packet reception statistics. By using the classification results, packet retransmissions can be minimized.

The second paper "Effects of Non-flat Interfaces in Human Skin Tissues on the In-Vivo Tera-Hertz Communication Channel" by K. Yang, Q.H. Abassi, N. Chopra, M. Munoz, Y. Hao, and A. Alomainy investigates the effects of the interface type between the epidermis and dermis layers within the human skin tissue. Influence of roughness and antenna locations is presented. Impact of sweat ducks is also considered.

The third paper is "A Statistical Model for the MIMO Channel with Rough Reflection Surfaces in the THz Band" by Zheng Xu, Xiaodai Dong, and Jens Bornemann. Therein, MIMO channel model for THz communication is presented. It is highlighted how there are significant differences between THz and lower frequencies. For example, the MIMO multiplexing gain at THz can be significantly limited by sparse channels (the sparsity depends on the roughness of the surfaces). Relationship between capacity and roughness is presented.

The proper molecular noise model is still an important open problem. The fourth paper "A discussion on molecular absorption noise in the terahertz band" by J. Kokkoniemi, J. Lehtomäki, and M. Juntti presents the first comprehensive survey on various possible models for molecular noise. It is shown that the molecular noise behaves extremely differently if the absorbed energy becomes (say) heat or if it is modeled similarly to multiple scattering energy (with or without emission delay and with or without propagation delay).

The papers have presented various aspects on THz band communication in nanonetworks. As presented in these papers, there are still a number of important open research issues. Therefore, we hope that these papers will inspire the readers to further advance THz band wireless communication.

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