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Title:Channel modeling and capacity analysis for electromagnetic wireless nanonetworks in the terahertz band
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Abstract:Nanotechnologies promise new solutions for several applications in the biomedical, industrial and military fields. At the nanoscale, a nanomachine is considered as the most basic functional unit which is able to perform very simple tasks. Communication among nanomachines will allow them to accomplish more complex functions in a distributed manner. In this paper, the state of the art in molecular electronics is reviewed to motivate the study of the Terahertz Band (0.1-10.0 THz) for electromagnetic (EM) communication among nano-devices. A new propagation model for EM communications in the Terahertz Band is developed based on radiative transfer theory and in light of molecular absorption. This model accounts for the total path loss and the molecular absorption noise that a wave in the Terahertz Band suffers when propagating over very short distances. Finally, the channel capacity of the Terahertz Band is investigated by using this model for different power allocation schemes, including a scheme based on the transmission of femtosecond-long pulses. The results show that for very short transmission distances, in the order of several tens of millimeters, the Terahertz channel supports very large bit-rates, up to few terabits per second, which enables a radically different communication paradigm for nanonetworks.
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