Classical Methods Cannot be Directly applied in The Nano-Domain

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- **Abstract:**

• It is possible to identify individual molecules through their unique noise particles in current nanocommunication signals. Improved knowledge of the molecular origin and interaction of nanoparticle-based carbon nanotube-based electronic noise should lead to the development of electronics that use noise to improve their performance rather than degrade it.

- **Keywords:** Nanocommunications , terahertz , electromagnetic waves , nanoantenna

Introduction •

Quantum interference or quantum parallelism gives us enormous computational power, especially in source coding, where information about the entire content is needed instead of individual inputs. Molecular communication is the sending and receiving of information encoded in molecules , while electromagnetic communication is the sending and receiving of electromagnetic radiation from various nanoscale devices . Of these methods, molecular communication and electromagnetic communication are considered wireless methods. In electromagnetic communication, electromagnetic communication between nanosensors depends on the development and fabrication of two important parts, the nanoantenna and its associated transceiver . At the nanoscale, graphene-based antennas are used to transmit EM waves. Graphene is an extremely thin single-atom sheet of confined carbon atoms arranged on a crystal lattice . Due to the extremely small dimensions of nanosensors, nanoantennas need to operate at very high frequencies to be useful. However, using graphene helps to solve this problem to a great extent.

- **classical methods cannot be directly applied in the nano-domain.**

Nanodevices communicate at frequencies of about 1.0 to 10 terahertz. Due to the severe limitations of nanodevices in terms of size and energy, the generation of high-power signals at terahertz frequencies is not practical. Therefore, classical communication patterns based on continuous signal communication cannot be implemented and for WNSNs, short-pulse modulation techniques of time domain (OOK-TS: Keying Off-On) are used. These techniques are especially used in cases such as frequency detection systems and also the nano-Internet of Things. Waves as information carriers are similar to classical communications. However, due to the severe shortage of resources and quantum effects of materials, classical methods cannot be directly applied in the nano-domain. Hence, it is necessary to use new materials and techniques.

- **Quantization and aliasing (Nyquist) in digital and analog signal processing**

The phenomenon of aliasing occurs when the sampling frequency is lower than the Nyquist rate. In the frequency domain, this phenomenon appears as a display of high frequencies in the low frequency range. In the time domain, this phenomenon also causes the loss of signal information. Therefore, aliasing is a nuisance phenomenon and must be eliminated. There are various ways to deal with aliasing, one of which is to observe the Nyquist rate. Unfortunately, many signals in the surrounding environment do not have a specific frequency range and for these signals, it is not possible to observe the Nyquist rate. A suitable solution for storing these types of signals is to remove the high frequencies of the signal by means of an analog low-pass filter before storing the signal.

- **"Nanocommunications" (noise) Low-frequency random oscillations in many nanocommunications devices, including nanoelectronics**

Noise is a low-frequency random oscillation that occurs in many nanocommunication devices, including nanoelectronics, the environment, and organisms. Noise can obscure signals, so it is often omitted from electronic and radio transmissions. The origin of noise in nanoelectronics is currently mostly in carbon nanotubes based on the nanocommunicative functions and the structure of graphene particles in nanotubes in interaction for nanocommunication purposes by (nanoparticles) in single-walled carbon nanotubes (SWCNTs) and multi-walled CNTs. Nanomaterials with high surface-to-volume ratio of noise generated by nanoelectrons are very attractive because they are very sensitive to changes in their surface. A representative material of this type is carbon nanotubes, which are rolled sheets of hexagonal graphene lattice, which are only one carbon atom thick.In nanocommunications, different molecules give off unique acoustic signals related to the properties of the molecules. The strength of the interaction between carbon nanotubes and the molecules arises from the noise signals. In nanocommunications, the signal generated by the carbon nanotube-based electronic nanoparticles is modified following the absorption of specific single molecules. This is because the absorbing molecule creates a trap state in the carbon nanotube, which causes it to conduct. This means that carbon nanotube-based nanocommunications devices are very sensitive. They can detect an unprecedented amount of single molecules. The ability to characterize single molecules using highly sensitive nanoelectronics is an exciting prospect in the field of sensors, especially for neurosensory and biosensor applications. The use of acoustic signals to detect molecular activity ((interaction) or (active orbital)) is attractive. In nanocommunications and interaction with carbon nanotube-based electronic nanoparticles, the sensitivity of signal detection may be increased by the generation of controllable noise. These carbon nanotube-based nanocommunicators demonstrate the possibility of identifying individual molecules through their unique noise particles in current nanocommunicator signals. Improved knowledge of the molecular origin and interaction of nanoparticle-based carbon nanotube-based electronic noise should lead to the development of electronics that use noise to improve their performance rather than degrade it.

• (Nanocommunications) Short Pulse Time Domain Modulation Techniques (OOK-TS: Keying Off-On)

Classical communication models based on continuous signal communication cannot be implemented, and for WNSNs, short time-domain keying (OOK-TS: Keying Off-On) pulse modulation techniques are used. Therefore, these techniques are especially used in cases such as frequency detection systems as well as the nano-Internet of Things. Waves as information carriers similar to classical communications. However, due to the severe resource shortage and quantum effects of materials, classical methods cannot be directly applied to the nano-domain. Hence, it is necessary to use new materials and techniques. Nanodevices communicate at frequencies of about 1.0 to 10 terahertz. Due to the severe limitations of nanodevices in terms of size and energy, generating high-power signals at terahertz frequencies is not practical. In a molecular communication system, the transmitter sends information by chemical molecules called information molecules, and after being propagated in the environment, it is received and decoded by the communication receiver. Communication theories play a special role in modeling, analyzing, and designing molecular communication systems. Nano-network is a nano-scale communication network between nano-devices. Nano-devices face special challenges in performance due to limitations in processing power management capabilities . Hence, these devices are expected to perform simple tasks that require different and novel approaches. In nano-communication, different molecules give off unique acoustic signals related to the properties of the molecules. There are several nano-communication technologies that require the use of external excitation and measurement to work. Wireless communication between nano-networks and micro- and macro-devices and equipment can meet this need.Molecular communication is the sending and receiving of information encoded in molecules , while electromagnetic communication is the sending and receiving of electromagnetic radiation from different nano-devices Of these methods, molecular communication and electromagnetic communication are wireless methods .

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