From Medical Diagnostic Instruments to Therapeutic Proteins

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Abstract

Thanks to recent advances in medical technology and biopharmaceuticals, mathematical modeling and data analysis are playing increasingly important roles in modern health care. To enable the widespread use of precision medicine, scientists have developed a novel medical diagnostic instrument that has the potential to fundamentally change health care delivery by providing superior biomarker measurements. This instrument is known as a field effect transistor (FET), and in this talk a new mathematical model for FET experiments will be presented. It will be shown through direct numerical simulations that this model provides novel findings that are not directly observable experimentally and yields insight into the nature of FET experiments.

In addition to this new and exciting medical diagnostic instrument, a class of biologically based medicines known as monoclonal antibodies will also be discussed. These are therapeutic proteins used to treat a number of diseases ranging from rheumatoid arthritis to certain kinds of cancers. Though these drugs show extraordinary promise in treating several diseases, they must undergo a series of rigorous tests to ensure safety and efficacy before FDA approval. To this end, chemists use a technique known as nuclear magnetic resonance (NMR) spectroscopy. Machine learning algorithms for classifying NMR spectra will be discussed, and it will be shown that combining the Monge-Ampere distance with the k-medoids algorithm enables superior classification of NMR spectra of monoclonal antibodies.