EEI-KOLLOQUIUM

Clues From Digital Radio - applied to Biomolecular Recognition

Prof. Dr. William D. Hunt
Georgia Institute of Technology, Atlanta, USA

Freitag, der 12.11.2010, 11^{00} Uhr
Cauerstraße 9, Raum 4.14 (Sondertermin)

Diskussionsleitung: Prof. Dr.-Ing. R. Weigel

At the heart of each and **every** biochemical or molecular biology event is something called molecular recognition. At any point in time in a cell there are thousands of different proteins and other biomolecules. These molecules manage to find one another and engage in interactive processes. Structures are built, signals are sent to surrounding cells...proteins. The cell is very busy and it is at the same time very precise. At the heart if this precision is a highly selective and highly sensitive transmit receive system whereby chemical signals are sent and for the most part are not misunderstood. It is a setup very similar to digital radio. The bit error rate must be very low, even in the presence of an enormous number of signals.

In my lab at Georgia Tech and in collaboration with P.J. Edmonson of Hamilton, Ontario, we have been working for several years on acoustic wave biosensors that are known to provide extremely high sensitivity and selectivity. For these sensors a receptor, or capture molecule is bound to the device surface and when its matching molecule (e.g. a ligand) attaches to it, the acoustic wave device is perturbed and the resonant frequency of the device shifts. We have taken this concept a bit further and have recently demonstrated that the details of this receptor-ligand interaction can be viewed quite nicely as an in-phase (I) and quadrature (Q) technique as is commonly used for the detection of orthogonal Mary signals in digital telecommunication systems.

Specifically, we have conducted a series of detection experiments using samples of explosives such as RDX (Cyclotrimethylene trinitramine or Royal Demolition eXplosive) and TNT(Trinitrotoluene), containing nitrous oxide (NO2) groups, and chemically analogous substances (e.g., musk oil). More precisely, our detection scheme involves the use of semi-orthogonal monoclonal anti-TNT and anti-RDX antibodies immobilized onto two separate sensor surfaces. The term semi-orthogonal represents the co-option of a term used heavily in digital radio for the purpose of describing chemical orthogonality. This feature of an antibody is referred to in the literature as antibody promiscuity. Upon mapping the measured frequency data of the sensors into the I-Q domain and with only two different receptor molecule types on two different sensors we have been able to effectively differentiate between the members of an extensive family of nitrous oxide compounds. We assert that there is a strong resemblance between digital radio system quadrature detection techniques and biomolecular recognition. The potential applications are expected to be far-reaching in many ways for example the sensor world for homeland security and the medical world for recognition of precursor molecules for cancer and other dehabilitating diseases.