Underlying mechanisms for non invasive glucose monitoring using a Multisensor concept - What do we know today?

The mechanism of e.g. a needle based glucose monitoring system utilising glucose oxidase (GOD) is known, well described and accepted. In general enzyme chemistry, or in the case of GOD based glucose sensing, enzyme chemistry combined with electro chemistry, is utilised in a wide field of applications. In contrast, electromagnetic (EM) methods used in medical diagnostics are extensively used (e.g. MRI, CT, NMR or OCT) as well, however, these non invasive monitoring systems in some cases can be much more difficult to understand, due to their less selective penetration of EM radiation into human tissue and the interaction of the EM field with that heterogeneous tissue.

Non invasive glucose monitoring (NIGM) based on the biophysical characterisation of human tissue using radio frequency electromagnetic radiation is a good example that has attracted significant scientific attention in trying to understand underlying dispersion mechanisms and processes. These mechanisms are highly frequency dependant and can thus not be generalised for NIGM per se.

Here we summarise the current thinking and to dates scientific understanding as well as open questions of the underlying biophysical mechanisms and phenomena related to the use of a Multisensor system. Beside temperature, acceleration and humidity measurements, this system utilises a wide frequency spectrum of electromagnetic radiation, featuring sensors for dielectric characterisation of the skin using a frequency range between 1-100 kHz, dielectric skin profiling within 100 kHz – 100 MHz, 1 and 2 GHz as well as optical characterisation of the micro vascular capillary bed. With these frequencies as well as skin depth related characterisation, different biophysical phenomena can be discriminated and even individual processes isolated from each other that can occur at the same time. The growing understanding of such *in vivo* processes combined with accumulating knowledge from basic *in vitro* research has lead to further improvements in the development as well as applicability of NIGM.