

# Antenna Design and Radio Propagation Modelling for Wireless Wearable Computers

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## 1. Background

The development of wearable computer systems has been growing rapidly. These systems are becoming smaller and more lightweight: no one wants to wear a bulky and heavy computer all day! We will soon see a wide range of unobtrusive wearable and ubiquitous computing equipment integrated into our everyday clothes. In a possible wearable computer, the monitor/display would be on a pair of glasses, the keyboard worn on the wrist, and the motherboard worn on the waist. It is undesirable to use bulky cables to connect these devices, so communication will be wireless, using an antenna.

Clearly wireless can provide the very high capacity communications needed, particularly if links operating at the speed of modern computer buses are used. Whilst the requirements have yet to be fully expressed, there may well be a need for low rate links from sensors and input devices on the arms and legs and high rate links from belt mounted processors to display units mounted on the head or wrist carrying, for example, real time video. The characterisation of the communication channel is thus vital in development of user-friendly wearable computers and is therefore the subject of this project jointly investigated by Queen Mary, University of London and University of Birmingham.

## 2. Introduction to the Project

The primary activity at UoB will be to conduct a measurement campaign to experimentally characterise the on-body channel. QMUL will in parallel develop miniature near field probe antennas for measurement campaign and a simulation tool that will provide physical insight into the propagation mechanisms present and enable its prediction in far more complex environment. Because of the confinement of the propagation to the body and its close locality, a novel prediction method, that will offer high accuracy, is proposed. Such prediction will be experimentally verified and enable the design of on-body systems operating over broad bands and/or mm wave lengths to be made avoiding very time consuming measurements. It will also be able to provide a basis for characterising changes in received signals from limb-based antennas with limb movement, thus opening up novel applications. Both institutions will initially contribute to preparation of the measurement system and finally collaborate in developing simple analytically or statistically based models that will then enable satisfactory air interface specifications to be developed.

We are also working on the important issue of the design of antennas for wireless wearable computers. We are particularly considering the following issues:

The antenna itself must be small and lightweight, since it is part of a lightweight device;

The small size of the antenna must not reduce its performance;

The antenna structure must be designed to have limited radiation power in the direction of the wearer, to minimize possible health problems;

The transmission power must be low, to prolong battery life and hence operating time.

## 3. References

1. Weiser M, "The Computer for the 21<sup>st</sup> Century," Scientific American 265, No. 3, 94-104 (September 1991).
2. P. S. Hall, C. Constantinou, Y. Hao and C. G. Parini, EPSRC case-for-support "Characterisation of On-Body Communication Channels", 2002