T6. Cooperative Wireless Communications

Abstract:

In the early days of wireless communications the research community used to view multipath-induced dispersion as an undesirable propagation phenomenon, which could only be combated with the aid of complex channel equalizers. The longer the Channel Impulse Response (CIR) was, the more complex the channel equalizer became. However, provided that the complexity of a sufficiently high-memory channel equalizer was affordable, the receiver could benefit from the fact that the individual propagation paths faded independently. To leaborate a little further, even if one of the paths was experiencing a high attenuation, there was a good chance that some of the other paths were not, which led to a potential diversity gain.

However, if the channel does not exhibit several independently fading paths, techniques of artificially inducing diversity may have to be sought. A simple option is to employ a higher direct-sequence spreading factor, which results in a higher number of resolvable multipath components and hence in an increased diversity gain. Naturally, this is only possible if either the available bandwidth may be extended according to the spreading factor or the achievable bitrate is reduced by the same factor. A whole host of classic diversity combining techniques may be invoked then for recovering the original signal.

An alternative technique of providing multiple independently faded replicas of the transmitted signal is to employ relaying, distributed space-time coding or some other cooperation-aided procedure, which is the subject of this course. One could also view the benefits of decode-and-forward based relaying as receiving and then flawlessly regenerating and re-transmitting the original transmitted signal from a relay - provided of course that the relay succeeded in error-freely detecting the original transmitted signal.

This course reviews the current state-of-the-art and proposes a number of novel relaying and cooperation techniques. An important related issue is the availability or the absence accurate channel information, which leads to the concept of coherent versus non-coherent detection at the realys and at the destination. Similarly, the related initial synchronization issues also have to be considered.

Naturally, when using hard-decisions in the transmission chain, we discard valuable soft-information, which results in an eroded performance, albeit also reduces the complexity imposed. Hence the hard-versus soft-decoding performance tradeoff will also be explored in the course, along with the benefits of interleaved random space-time coding invoked for multi-source cooperation.

Another important aspect of cooperative communications is constituted by the so-called Cooperative Multi-Point Processing (COMP) technique, which jointly processes all the signals gleaned at all the base-stations (BSs), which will also be covered by the proposed course. In most existing studies he interconnection of all the BSs is assumed to be perfect. By contrast, in this course realistic dispersion-contaminated optical interconnections will be considered.

Speaker's Biography:

Lajos Hanzo, School of ECS, University of Southampton, UK

Lajos Hanzo (http://www-mobile.ecs.soton.ac.uk) FREng, FIEEE, FIET, Fellow of EURASIP, DSc received his degree in electronics in 1976 and his doctorate in 1983. In 2009 he was awarded the honorary doctorate "Doctor Honoris Causa" by the Technical University of Budapest. During his 35-year career in telecommunications he has held various research and academic posts in Hungary, Germany and the UK. Since 1986 he has been with the School of Electronics and Computer Science, University of Southampton, UK, where he holds the chair in telecommunications. He has successfully supervised 80 PhD students, co-authored 20 John Wiley/IEEE Press books on mobile radio communications totalling in excess of 10 000 pages, published 1294 research entries at IEEE Xplore, acted both as TPC and General Chair of IEEE conferences, presented keynote lectures and has been awarded a number of distinctions. Currently he is directing an academic research team, working on a range of research projects in the field of wireless multimedia communications sponsored by industry, the Engineering and Physical Sciences Research Council (EPSRC) UK, the European IST Programme and the Mobile Virtual Centre of Excellence (VCE), UK. He is an enthusiastic supporter of industrial and academic liaison and he offers a range of industrial courses. He is also a Governor of the IEEE VTS. Since 2008 he has been the Editor-in-Chief of the IEEE Press and since 2009 a Chaired Professor also at Tsinghua University, Beijing. For further information on research in progress and associated publications please refer to http://www-mobile.ecs.soton.ac.uk