Hindawi Publishing Corporation
EURASIP Journal on Wireless Communications and Networking
Volume 2006, Article ID 79148, Pages 1–10
DOI 10.1155/WCN/2006/79148

Joint Downlink Power Control and Multicode Receivers for Downlink Transmissions in High Speed UMTS

Bessem Sayadi, Stefan Ataman, and Inbar Fijalkow

ETIS/ENSEA, University of Clergy-Pontoise/CNRS, 6 Avenue du Ponceau, 95014 Clergy-Pontoise, France

Received 30 September 2005; Revised 28 February 2006; Accepted 19 May 2006

We propose to combine the gains of a downlink power control and a joint multicode detection, for an HSDPA link. We propose an iterative algorithm that controls both the transmitted code powers and the joint multicode receiver filter coefficients for the high-speed multicode user. At each iteration, the receiver filter coefficients of the multicode user are first updated (in order to reduce the intercode interferences) and then the transmitted code powers are updated, too. In this way, each spreading code of the multicode scheme creates the minimum possible interference to others while satisfying the quality of service requirement. The main goals of the proposed algorithm are on one hand to decrease intercode interference and on the other hand to increase the system capacity. Analysis for the rake receiver, joint multicode zero forcing (ZF) receiver, and joint multicode MMSE receiver is presented. Simulation is used to show the convergence of the proposed algorithm to a fixed point power vector where the multicode user satisfies its signal-to-interference ratio (SIR) target on each code. The results show the convergence behavior for the different receivers as the number of codes increases. A significant gain in transmitted base station power is obtained.

1. INTRODUCTION

As wireless access to the internet rapidly expands, the need for supporting multirate services (voice, data, multimedia, etc.) over limited spectrum increases. CDMA technologies are being considered for third-generation wireless networks, UMTS. There are hence two channelization schemes for achieving multirate transmissions. The first, known as the variable spreading factor scheme, achieves variable-data rate transmission by assigning the radio link a single variable-length random spreading sequence. However, short codes, when subjected to a large delay-spread multipath channel loose their orthogonality and lead to a significant intersymbol interference (ISI). To circumvent this limitation, we consider the second option called multicode transmission. The high-rate data stream is split into several lower rate data substreams [1]. Each substream is spread by a specific spreading sequence and all the substreams are then transmitted synchronously as virtual users. A future transmission mode such as the high-speed downlink packet access (HSDPA [2]) will make wide use of multicode to considerably increase the data rate in the downlink with a peak-data rate in the range of 10–14 Mbit/s. All the spreading sequences are orthogonal to each other to avoid signal interference between parallel channel codes in a synchronous multipath free channel. However, multipath propagation partially destroys the orthogonality of the multicode transmission and leads to a significant self intercode interference which increases with the number of parallel codes for a multicode scheme. Therefore, the quality of the downlink under frequency selective fading environments is interference limited. In this paper, we consider a single cell environment where one or more users employ a multicode downlink transmission.

In order to improve the quality of the downlink which is typically defined in terms of the signal-to-interference ratio (SIR), a joint multicode reception was recently proposed in [3] with the assumption that the different codes have a fixed transmitting power. Based on a description of the signal received over fading code-division multiple-access channel, where many different data rates are considered, it is shown in [3] that the problem of recovering the multicode user can be expressed as a multiuser interference cancelation problem, where each channel code represents a virtual user.

Independently in literature, power control is proposed, classically for the link between the multiusers and the base station (BS), to overcome the near-far problem, to maintain the mobile station power consumption, and to reduce the cochannel interference. The power control approach assumes that a fixed receiver, usually the conventional (single user) receiver, is being used. It optimizes the communication between the mobiles and the BS by controlling the transmitted powers of the different users [4, 5].

Given the importance of power control, an extensive research is focused on this subject. In [6], two optimization criteria are considered in a single-cell case: minimizing total transmitted power and maximizing throughput. In [7], the optimum power vector is given and also statistics on the received power are considered. A statistical approach of the optimum power solution is developed in [8]. The existence (or feasibility) of this optimal power allocation is also considered in [7, 9]. A distributed and iterative power control algorithm where each user's power converges to the minimum power needed to meet its quality of service (QoS) specification is proposed in [10]. A joint optimization of both receiver filters and user transmit powers has been considered in [11] to find the jointly optimum powers and linear MMSE (minimum mean square error) filter coefficients. A similar approach is proposed in reference [12] where the authors employ a successive interference cancelation scheme. Recently, a unified approach of the uplink power control that is applicable to a large family of multiuser receivers is proposed in [13, 14], based on the large system results published in [15].

Based on the fact that for a fixed base station assignment the feasibilities of uplink and downlink are equivalent (see [16] for more details), the authors in [16] present a joint power control and base station assignment for the downlink. Many others researchers are interested on the study of the downlink power control such as [17–19]. In [17], the authors studied the joint optimal power control and beamforming in wireless networks. In [18], the authors studied the downlink power control allocation for multiclass wireless systems. However, in the case of HSDPA system, the way the base station (BS) must allocate the power on the different codes in the case of multicode transmission is still an open issue. It is indeed desirable for the BS not to use more transmission power than what it needs to. This paper proposes a possible way to solve this problem.

In order to achieve this goal, we propose in this paper to combine the downlink power control approach and the joint multicode detection, presented in [3], for the multicode user. We propose an algorithm which controls both the transmitted code powers at the BS and the joint multicode receiver filters implemented in the mobile. The resulted algorithm adapts the transmitted code's powers taking into account a multicode reception strategy at the mobile which aims to reduce the intercode interference. Mathematically, the strategy involves two alternate optimization problems which are resolved iteratively in the proposed algorithm. At each iteration first the receiver filter coefficients of the multicode user are updated to reduce the intercode interference and then the transmitted code powers are updated and assigned. So that, each spreading code of the multicode scheme creates the minimum possible interference to others while satisfying the quality of service requirement. This algorithm has as main goals to decrease intercode interference and to increase the system capacity. Using downlink power control, the BS output power is adapted to the radio link conditions.

The implementation of this approach, in the HSDPA mobile, requires interference measurements for each code. These measurements are envisaged in HSDPA standard [20]. We show, using simulations, that the resulting algorithm converges to a fixed point power vector where the multicode user satisfies its signal-to-interference ratio (SIR) target on each code. The feasibility of the proposed approach is based on the transmission of the requested code power via a feedback link in order to update the BS output powers. Such a feedback is considered in the HSDPA standard where the mobile transmits the channel quality indicator to the base station [2]. In this study, we consider the case of the joint zero forcing and the joint minimum mean square error (MMSE) multicode linear receivers for various scenarios where we compare their performance to those obtained by considering a bank of rake receivers considered, here, as the conventional power control strategy.

The paper is organized as follows. Section 2 introduces the proposed linear algebraic model which describes the signal received over time-dispersive fading channel including a hybrid multicode/variable spreading factor transmissions. Section 3 gives the problem statement. The proposed strategy is introduced in Sections 4 and 5, and its performance in a simplified HSDPA environment is assessed by means of numerical simulations in Section 6. Finally, Section 7 presents our conclusions.

Throughout this paper scalars, vectors, and matrices are lower case, lower-case bold and upper-case bold characters, respectively. $(\cdot)^T$, $(\cdot)^{-1}$ denote transposition and inversion, respectively. Moreover, $E(\cdot)$ denotes the expected value operator.

2. SYSTEM MODEL

We assume a multicode CDMA frequency division duplex cellular system. In each cell, K mobile users, each employing a different rate, communicate with a base station. Each user receives a frame with a standardized number of chips denoted by N_{chip}. Based on the quality of service required by user k, the base station assigns M_k spreading codes, the processing gain is denoted by G_k, at the condition that $N_{\mathrm{chip}} = G_k N_{\mathrm{bit}}^{(k)}$ where $N_{\mathrm{bit}}^{(k)}$ is the number of transmitted symbols for user k. Under the constraint that a constant chip rate, $1/T_c$, where T_c denotes the chip period, must be maintained, the symbol period, denoted here by $T_{s,k} = G_k T_c$, varies with the requested rate by user k. The index s is related to the symbol period and the index k is related to the kth user. In order to facilitate the description, the terminologies defined in Table 1 are used in the rest of this paper.

The path-loss attenuation between the BS and the kth user is denoted by z_k. In the no-shadowing scenario, the path loss (PL) is modeled as a simple distance-dependent loss:

$$z_k^{(\mathrm{PL})} \approx \lambda d_k^{-\varsigma} \tag{1}$$

Table 1: Terminology description.

Notation	Description
K	the number of user
N_{chip}	the number of chips in a one radio block
G_k	the spreading factor assigned to the kth user
M_k	the number of spreading code assigned to the kth user
$N_{\text{bit}}^{(k)}$	the number of bits or symbols transmitted in a one radio block
T_c	the common chip period
$T_{s,k}$	the symbol period related to the kth user, $1 \leq k \leq K$
z_k	the attenuation due to the path loss and the shadowing
L	the number of paths
τ_i	the delay of the ith path
$p_m^{(k)}$	the power of the mth code, $1 \leq m \leq M_k$ of the kth user
n	the symbol index time
$\mathbf{b}^{(k)}$	the transmitted symbol vector by the kth user
$\mathbf{C}^{(k)}$	the spreading coding matrix related to the kth user
$\mathbf{W}^{(k)}$	the code's power matrix related to the kth user
$\mathbf{H}^{(k)}$	the channel matrix related to the kth user
$\mathbf{n}$	the noise vector

or, in dB,

$$z_k^{(\text{PL})}[\text{dB}] \approx 10\log_{10}(\lambda) - 10 \cdot \varsigma \cdot \log_{10}(d_k), \tag{2}$$

where the constants λ usually depend on the frequency used, as well as the height of the base station and the wireless terminal. The d_k is the distance from user k to the base station. The attenuation coefficient ς is usually between 2 and 6 for most indoor and outdoor environments. The model presented in (1) is a general form for the most empirical and semiempirical path-loss attenuation model. For more details, the reader can refer to [21].

In the shadowing case (SH), the variation due to shadowing is added to the path-loss value to obtain the variations. Therefore, the path-loss can be modeled as the product of a distance-dependent path-loss attenuation and a random log-normally distributed shadowing effect [21]:

$$z_k^{(\text{PL,SH})} \approx \lambda d_k^{-\varsigma} 10^{\xi_k/10}, \quad \xi_k \sim \mathcal{N}(0, \sigma_\xi^2) \tag{3}$$

or, in dB,

$$z_k^{(\text{PL,SH})}[\text{dB}] \approx 10\log_{10}(\lambda) - 10 \cdot \varsigma \cdot \log_{10}(d_k) + \xi_k, \tag{4}$$

where $\mathcal{N}(0, \sigma_\xi^2)$ is the Gaussian density with mean 0 (in dB) and variance σ_ξ^2 (in dB). In the rest of the paper, we denote $z_k^{(\text{PL,SH})}$ by z_k.

The effect of the downlink multipath channel is represented by a vector with L paths denoted, here, by

$$\mathbf{h} = [\alpha_0, \alpha_1, \ldots, \alpha_{L-1}]^T \tag{5}$$

with corresponding delays $[\tau_0, \ldots, \tau_{L-1}]$. Therefore, the channel, corresponding to user k, is described as the following:

$$\mathbf{h}_k = z_k \mathbf{h}. \tag{6}$$

The transmit power towards the kth user on mth code will be denoted by $p_m^{(k)}$. The transmitted signal for the kth user can be written as

$$y_k(t) = \sum_{n=0}^{N_{\text{bit},k}-1} \sum_{m=1}^{M_k} \sqrt{p_m^{(k)}} b_m^{(k)}(n) c_m^{(k)}(t - nT_{s,k}), \tag{7}$$

where

$$c_m^{(k)}(t) = \sum_{q=0}^{G_k-1} c_m^{(k),(q)} \psi(t - qT_c) \tag{8}$$

with G_k the spreading factor for the kth user and $b_m^{(k)}(n)$ is the transmitted symbol at time n for the kth user on the mth channel-code denoted by $c_m^{(k)}(t) \cdot \psi$ is a normalized chip waveform of duration T_c. The base-band received signal at the desired user can be written as

$$\begin{aligned} r(t) \\ = \sum_{k=1}^{K} z_k \sum_{l=0}^{L-1} \alpha_l \sum_{n=0}^{N_{\text{bit},k}-1} \sum_{m=1}^{M_k} \sqrt{p_m^{(k)}} b_m^{(k)}(n) c_m^{(k)}(t - nT_{s,k} - \tau_l) + n(t), \end{aligned} \tag{9}$$

where $n(t)$ is a zero-mean additive white Gaussian noise (AWGN) process.

The received signal is time-discretized at the rate of $1/T_c$, leading to a chip-rate discrete-time model that can be written as

$$\begin{aligned} r_l &= r(lT_c) \\ &= \sum_{k=1}^{K} z_k \sum_{l=0}^{L-1} \alpha_l \sum_{n=0}^{N_{\text{bit},k}-1} \sum_{m=1}^{M_k} \sqrt{p_m^{(k)}} b_m^{(k)}(n) c_m^{(k)}((l - nG_k - t_{l,k})T_c) \\ &\quad + n(lT_c), \end{aligned} \tag{10}$$

where $t_{l,k} = \lfloor \tau_l / G_k \rfloor$ is the time-discretized path delay in sample intervals (chip period).

Throughout the paper, we employ a block model. The blocks of transmitted symbols for each user, $k = 1, \ldots, K$, are concatenated in a vector:

$$\mathbf{b}^{(k)} = \left[b_1^{(k)}(0), \ldots, b_{M_k}^{(k)}(0), \ldots, b_{M_k}^{(k)}(N_{\text{bit}}^{(k)} - 1) \right]^T \tag{11}$$

containing $N_{\text{bit}}^{(k)}$ bits transmitted with the different codes for a given user, k.

The transmission of the data sequence over the CDMA channel can be expressed by the received sequence $\mathbf{r}$ [3]:

$$\begin{aligned} \mathbf{r} &= [r_1, \ldots, r_{N_{\text{chip}}+L-1}]^T \\ &= \sum_{k=1}^{K} \mathbf{C}^{(k)} \tilde{\mathbf{H}}^{(k)} \mathbf{W}^{(k)} \mathbf{b}^{(k)} + \mathbf{n}, \end{aligned} \tag{12}$$

where $\widetilde{\mathbf{H}}^{(k)} = \operatorname{diag}(\mathbf{h}_k, \ldots, \mathbf{h}_k)$ is of size $(N_{\text{bit}}^{(k)} M_k L, N_{\text{bit}}^{(k)} M_k)$ and $\mathbf{W}^{(k)} = \operatorname{diag}(\mathbf{P}^{(k)}, \mathbf{P}^{(k)}, \ldots, \mathbf{P}^{(k)})$ of size $N_{\text{bit}}^{(k)} M_k$ where $\mathbf{P}^{(k)} = \operatorname{diag}(\sqrt{p_1^{(k)}}, \sqrt{p_2^{(k)}}, \ldots, \sqrt{p_{M_k}^{(k)}})$ and $\operatorname{diag}(\mathbf{X})$ represents the diagonal matrix containing only the diagonal elements of the matrix $\mathbf{X}$. The matrix $\mathbf{C}^{(k)}$ represents the code matrix of size $((N_{\text{chip}} + L - 1), N_{\text{bit}}^{(k)} M_k L)$ built as follows:

$$\begin{aligned}
\mathbf{C}^{(k)} &= \left[\mathbf{v}_{0,0,0}^{k}, \ldots, \mathbf{v}_{N_{\text{bit},k}-1, M_k-1, L-1}^{k}\right],\\
\mathbf{v}_{n,m,l}^{k} &= \left[\mathbf{0}_{nG_k}^{T}, \mathbf{u}_{m,l}^{k^T}, \mathbf{0}_{(N_{\text{bit},k}-n-1)G_k}^{T}\right]^{T},\\
\mathbf{u}_{m,l}^{k} &= \left[\mathbf{0}_{t_l}^{T}, \mathbf{c}_{m}^{k^T}, \mathbf{0}_{L-t_l-1}^{T}\right]^{T},\\
\mathbf{c}_{m}^{k} &= \left[c_m^k(1), \ldots, c_m^k(G_k)\right]^{T},
\end{aligned} \tag{13}$$

where $n = 0, \ldots, N_{\text{bit},k} - 1$, $m = 0, \ldots, M_k - 1$, and $l = 0, \ldots, L - 1$. $\mathbf{0}_n$ denotes the null vector of size n. The vector $\mathbf{n}$, of length $N_{\text{chip}} + L - 1$, represents the channel noise vector with N_0 as a power spectral density.

The vector $\mathbf{c}_m^{(k)} = [c_m^k(1), \ldots, c_m^k(G_k)]^T$ denotes the spreading code vector of length G_k related to the kth user. It is obtained by the discretization at the chip rate of the function $c_m^{(k)}(t)$ given by (8). The index m denotes the index of the spreading code in the multicode scheme containing M_k codes.

The model just proposed for a multirate and multicode DS-CDMA system follows the structural principles of practical downlink UMTS and leads to a convenient algebraic form which allows for a powerful receiver design for a multicode multirate CDMA system.

For the sake of simplicity, the propagation channel is assumed to be time invariant during the transmission of N_{chip} chips. We also assume that the interferences due to symbols before and after N_{chip} data block can be completely cancelled. This is possible when those interfering symbols are known by the receiver via a training sequence. The model presented in (12) can be generalized to incorporate scrambling codes and multiple antenna transmissions.

3. PROBLEM STATEMENT

Without loss of generality, the user 1 is chosen as the user of interest. By denoting $\mathbf{A}^{(k)} = \mathbf{C}^{(k)} \widetilde{\mathbf{H}}^{(k)}$, the received signal can be expressed as

$$\mathbf{r} = \underbrace{\mathbf{A}^{(1)}\mathbf{W}^{(1)}\mathbf{b}^{(1)}}_{\text{desired signal + intercode interference}} + \underbrace{\sum_{k=2}^{K} \mathbf{A}^{(k)}\mathbf{W}^{(k)}\mathbf{b}^{(k)}}_{\text{MAI + ISI}} + \underbrace{\mathbf{n}}_{\text{noise}}, \tag{14}$$

where we separate the user of interest's signal, the multiple access interference (MAI), and intersymbol interference (ISI) caused by the other users and the noise. The first term in (14) contains the useful signal and the intercode interference caused by the multicode scheme.

Let $\mathbf{F}$ denote the joint multicode receiver filter employed by the receiver of user 1, user of interest. From the output of the joint multicode receiver, $\mathbf{y} = \mathbf{F}^T\mathbf{r}$, the SIR of virtual user of interest can be written for code m and symbol n as the following:

$$\text{SIR}(m, n) = \frac{p_m E\left(\beta(\mathbf{F}, \mathbf{h}_k, \mathbf{C}^{(k)}) \left| \hat{b}_m^{(1)}(n) \right|^2\right)}{E\left(\left| \Omega(p_{m' \neq m}) \right|^2\right)} \tag{15}$$

for $m = 1, \ldots, M_1$, $m' = 1, \ldots, M_1$, and $n = 1, \ldots, N_{\text{bit},1} \cdot \Omega(p_{m' \neq m})$ is the sum of the intercode interferences, the multiple access interference, the intersymbols interference, and the noise. $\beta(\mathbf{F}, \mathbf{h}_k, \mathbf{C}^{(k)})$ denotes the term depending on the multicode receiver filter coefficients, the spreading code and the channel coefficients. p_m denotes the power assigned to the mth code. In the sequel, we present the expression of the terms $\beta(\mathbf{F}, \mathbf{h}_k, \mathbf{C}^{(k)})$ and $\Omega(p_{m' \neq m})$ in the case of the rake, the zero forcing, and the MMSE multicode receivers.

The aim of the power control algorithm in CDMA system is to assign the mobile the minimum power necessary to achieve a certain QoS which is typically defined in terms of SIR. In this context, the most employed power control algorithm was proposed by Foschini and Miljanic in [10] and it is known as distributed power control (DPC). The optimum transmission power of user k, supposed monocode user, is computed iteratively in order to achieve an SIR target denoted here by $\text{SIR}_{\text{target}}$.

$$p_k(n + 1) = \frac{\text{SIR}_{\text{target}}}{\text{SIR}(n)} p_k(n). \tag{16}$$

When the target SIR is achieved, the power's updating stops. This approach assumes a fixed receiver, usually a single receiver. To overcome this limitation, Ulukus and Yates in [11] proposes to optimize jointly the multiuser receiver and the user's power in the uplink. As the main result, it is shown that the same performance as the DPC algorithm is achieved with less transmitted power. In continuation of Yates' idea of a combined power control and receiver adaptation in a CDMA uplink, we develop, here, a joint power control and multicode receiver adaptation algorithm suitable for a high-speed UMTS downlink.

So, the problem is to determine the different code powers, p_m, and multicode receiver filter coefficients, such that the allocated power to the multicode user is minimized while satisfying the quality of service requirement on each code, $\text{SIR}_m \geq \text{SIR}_{\text{target}}$, where $\text{SIR}_m = E_n((\text{SIR}(m, n)))$, $m = 1, \ldots, M_1$, and $\text{SIR}_{\text{target}}$ is the minimum acceptable level of SIR for each code. E_n denotes the expectation over the symbol index. Therefore, the problem can be stated mathematically as follows:

$$\min_{\mathbf{p}} \sum_{m=1}^{M_1} p_m \tag{17}$$

constrained to

$$\begin{gathered}p_m \geq \mathrm{SIR}_{\mathrm{target}} \frac{E\left(\left|\Omega\left(p_{m'\neq m}\right)\right|^2\right)}{E\left(\beta\left(\mathbf{F},\mathbf{h}_k,\mathbf{C}^{(k)}\right)\left|\widehat{b}_m^{(1)}(n)\right|^2\right)} \\ p_m \leq p_{\max}, \quad m = 1,\dots,M_1,\end{gathered} \tag{18}$$

where $p_{\max}$ denoted the maximum allowed transmitted user's power.

The following optimization problem is difficult since the constraints denominators are also power dependent. The solution is to consider a double optimization problem where an inner optimization is inserted in the constraint set as the following:

$$\min_{\mathbf{p}} \sum_{m=1}^{M_1} p_m \tag{19}$$

constrained to

$$\begin{gathered}p_m \geq \mathrm{SIR}_{\mathrm{target}} \min_{\mathbf{F}} \frac{E\left(\left|\Omega\left(p_{m'\neq m}\right)\right|^2\right)}{E\left(\beta\left(\mathbf{F},\mathbf{h}_k,\mathbf{C}^{(k)}\right)\left|\widehat{b}_m^{(1)}(n)\right|^2\right)}, \\ p_m \leq p_{\max}, \quad m = 1,\dots,M_1.\end{gathered} \tag{20}$$

In [11], the equivalence between the optimization formulation given by (17) and the formulation given by (19) is demonstrated.

The second optimization formulation is a two alternate optimization problem. The first optimization problem involved in (19), and called the outer optimization, is defined over the code power. Whereas the second one, called the inner optimization, which is involved in (20), assumes a fixed power vector. It is defined over the filter coefficients of the multicode receiver. In this stage, we optimize the multicode filter coefficients to maximally suppress the intercode interference. The implementation of these two alternate optimization problems are realized iteratively in the algorithm described in the next section.

4. COMBINED DOWNLINK POWER CONTROL AND JOINT MULTICODE RECEIVERS

In this section, we propose to combine the downlink power control and the joint multicode receivers. The objective of the algorithm is to achieve an output SIR equal to a target $\mathrm{SIR}_{\mathrm{target}}$ for each assigned code to the multicode user. To do this, we exploit the linear relationship between the output SIR and transmit code power as is seen in (15). The proposed algorithm is a two-stage algorithm. First, we adjust the filter coefficients for a fixed code power vector, the inner optimization. Second, we update the transmitted code powers to meet the SIR constraints on each code for the chosen filter coefficients using (16). The description of the proposed algorithm is as follows:

```
(1) $i = 0$, start with initial powers $p_0^{(1)},\dots,p_{M_1}^{(1)}$.
(2) Receiver parameter calculation and receiver output SIR
    calculation.
(3) Update the code powers using
    $p_m^{(1)}(i+1) = (\mathrm{SIR}_{\mathrm{target}}/E_n[\mathrm{SIR}(m,n)])p_m^{(1)}(i)$, for $m =$
    $1,\dots,M_1$.
(4) $[\mathbf{W}(i+1)]_{j,j} = \sqrt{p_m^{(1)}(i+1)}$, with $j = m+(n-1)M_1$
    where $m = 1,\dots,M_1$ and $n = 1,\dots,N_{\mathrm{bit},1}$.
(5) $i = i+1$, stop if convergence is reached; otherwise, go to
    step (2).
```

Algorithm 1

The subscript 1 marks out the considered multicode user.

If we consider also a maximum transmit power limitation $p_m^{\max}$, for $m = 1,\dots,M_1$, step (3) from the above algorithm is modified according to

$$p_m^{(1)}(i+1) = \min\left\{\frac{\mathrm{SIR}_{\mathrm{target}}^{(1)}}{E_n\left[\,\mathrm{SIR}(m,n)\right]}p_m^{(1)}(i), p_m^{\max}\right\}. \tag{21}$$

The new code power calculated in step (3) are transmitted via a feedback link to the BS.

In the sequel, we present the SIR derivation in the case of the zero forcing and the MMSE multicode joint receivers.

5. JOINT MULTICODE RECEIVER STRUCTURES

In this section, we derive the expression of the output SIR on each code by considering the joint multicode receivers: ZF and MMSE.

The received signal given by (14) can be written as

$$\mathbf{r} = \mathbf{AWb} + \widetilde{\mathbf{n}} \tag{22}$$

by denoting $\widetilde{\mathbf{n}} = \sum_{k=2}^{K}\mathbf{A}^{(k)}\mathbf{W}^{(k)}\mathbf{b}^{(k)} + \mathbf{n}$.

5.1. *Rake receiver*

The conventional data estimator consists of a bank of rake receivers. In this case, the output signal is

$$\mathbf{y}_{\mathrm{Rake}} = \mathbf{A}^H\mathbf{r} = \mathbf{\Gamma}\mathbf{W}\mathbf{b} + \mathbf{A}^H\widetilde{\mathbf{n}}, \tag{23}$$

where $\mathbf{\Gamma} = \mathbf{A}^H\mathbf{A}$.

We separate the desired user's symbols, the intercode interference generated by the multicode transmission and the MAI + ISI + noise generated by the noise and the other users,

$$\mathbf{y}_{\mathrm{Rake}} = \underbrace{\mathrm{diag}\{\mathbf{\Gamma}\mathbf{W}\mathbf{b}\}}_{\text{desired symbols}} + \underbrace{\overline{\mathrm{diag}}\{\mathbf{\Gamma}\mathbf{W}\mathbf{b}\}}_{\text{intercode interference}} + \underbrace{\mathbf{A}^H\widetilde{\mathbf{n}}}_{\mathrm{MAI}+\mathrm{ISI}+\text{noise}}, \tag{24}$$

where $\overline{\mathrm{diag}}(\mathbf{X}) = \mathbf{X} - \mathrm{diag}(\mathbf{X})$ represents a matrix with zero diagonal elements containing all but the diagonal elements of $\mathbf{X}$.

The useful signal for the nth transmitted symbol on the mth code is given by

$$E\left\{\left(\left[\mathbf{\Gamma}\mathbf{W}\right]_{j,j}b_1^{(1)}(n)\right)^2\right\} = \left(\left[\mathbf{\Gamma}\mathbf{W}\right]_{j,j}\right)^2 E\left\{\left|b_1^{(1)}(n)\right|^2\right\}, \tag{25}$$

where $[\mathbf{X}]_{j,j}$ denotes the element in the jth row and jth column of the matrix $\mathbf{X}$.

The interference and the noise are given by

$$I = E\Big\{\big(\boldsymbol{\Gamma}\mathbf{W}\mathbf{b} - \operatorname{diag}\{\boldsymbol{\Gamma}\mathbf{W}\mathbf{b}\} + \mathbf{A}^H\tilde{\mathbf{n}}\big)^2\Big\}. \tag{26}$$

We consider in the sequel that $E\{|b_1^{(1)}(n)|^2\} = 1$.

After developing the term I and taking the jth diagonal element, the SIR at the output of the rake receiver related to the nth transmitted symbol on the mth code can be expressed as follows by denoting $\boldsymbol{\Gamma}' = \boldsymbol{\Gamma}\mathbf{W}$ and $\mathbf{R}_{\tilde{n}} = E[\tilde{\mathbf{n}}\tilde{\mathbf{n}}^T]$ as the covariance matrix of the MAI, ISI and noise,

$$\mathrm{SIR}_{\mathrm{Rake}}(m,n) = \frac{\big([\boldsymbol{\Gamma}']_{j,j}\big)^2}{\big[(\boldsymbol{\Gamma}')^2\big]_{j,j} - \big[(\boldsymbol{\Gamma}')_{j,j}\big]^2 + \big[\boldsymbol{\Gamma}'\mathbf{R}'_{\tilde{n}}\boldsymbol{\Gamma}\big]_{j,j}} \tag{27}$$

for $j = m + (n-1)M_1$ where $m = 1,\dots,M_1$ and $n = 1,\dots,N_{\mathrm{bit},1}$.

5.2. Joint multicode zero forcing receiver

In the case of the joint ZF receiver, the output signal is

$$y_{\mathrm{ZF}} = \boldsymbol{\Gamma}^{-1}\mathbf{y}_{\mathrm{Rake}} = \mathbf{W}\mathbf{b} + \boldsymbol{\Gamma}^{-1}\mathbf{A}^H\tilde{\mathbf{n}}. \tag{28}$$

The joint ZF receiver leading to the estimate of the desired symbols, $\mathbf{b}$, is called zero forcing since it tries to force the residual intercode interference to zero.

Therefore, the SIR at the output of the joint ZF receiver relating to the nth transmitted symbol on the mth code can be expressed as follows:

$$\mathrm{SIR}_{\mathrm{ZF}}(m,n) = \frac{[\mathbf{W}]_{j,j}^2}{\big[\boldsymbol{\Gamma}^{-1}\mathbf{A}^H\mathbf{R}_{\tilde{n}}\mathbf{A}\boldsymbol{\Gamma}^{-H}\big]_{j,j}} \tag{29}$$

for $j = m + (n-1)M_1$ where $m = 1,\dots,M_1$ and $n = 1,\dots,N_{\mathrm{bit},1}$.

5.3. Joint multicode MMSE receiver

The joint multicode MMSE linear receiver minimizes the output mean squared error

$$E\Big\{\big\|\mathbf{F}\mathbf{y}_{\mathrm{Rake}} - \mathbf{W}\mathbf{b}\big\|^2\Big\} \tag{30}$$

with respect to $\mathbf{F}$ which yields

$$\mathbf{F} = \mathbf{W}^2\boldsymbol{\Gamma}^H\big[\boldsymbol{\Gamma}\mathbf{W}^2\boldsymbol{\Gamma}^H + \mathbf{A}^H\mathbf{R}_{\tilde{n}}\mathbf{A}\big]^{-1}. \tag{31}$$

Therefore, the output signal from the MMSE receiver yields, by denoting $\mathbf{W}_0 = \mathbf{F}\boldsymbol{\Gamma}$,

$$\mathbf{y}_{\mathrm{MMSE}} = \mathbf{F}\mathbf{y}_{\mathrm{Rake}} = \mathbf{W}_0\mathbf{W}\mathbf{b} + \mathbf{W}_0^{-1}\boldsymbol{\Gamma}\mathbf{A}^H\tilde{\mathbf{n}}. \tag{32}$$

Now, we can separate the desired user's symbols, the intercode interference generated by the multicode transmission and the MAI + ISI + noise generated by the noise and the other users,

$$\mathbf{y}_{\mathrm{MMSE}} = \operatorname{diag}\{\mathbf{W}_0\mathbf{W}\mathbf{b}\} + \overline{\operatorname{diag}}\{\mathbf{W}_0\mathbf{W}\mathbf{b}\} + \mathbf{W}_0\boldsymbol{\Gamma}^{-1}\mathbf{A}^H\mathbf{A}^H\tilde{\mathbf{n}}. \tag{33}$$

The SIR at the output of the MMSE receiver relating to the nth transmitted symbol on the mth code can be expressed as follows by denoting $\mathbf{W}' = \mathbf{W}_0\mathbf{W}$ as

$$\mathrm{SIR}_{\mathrm{MMSE}}(m,n) = \frac{\big([\mathbf{W}']_{j,j}\big)^2}{\big[\mathbf{W}'\mathbf{W}'^H\big]_{j,j} - \big([\mathbf{W}']_{j,j}\big)^2 + \big[\mathbf{W}_0^{-1}\boldsymbol{\Gamma}\mathbf{A}^H\mathbf{R}_{\tilde{n}}\mathbf{A}\boldsymbol{\Gamma}^{-1}W_0^H\big]_{j,j}} \tag{34}$$

for $j = m + (n-1)M_1$ where $m = 1,\dots,M_1$ and $n = 1,\dots,N_{\mathrm{bit},1}$.

The proposed approach involves complex matrix inverse computations due to the employment of instantaneous MMSE filtering. This drawback can be recovered by replacing instantaneous MMSE filtering with adaptive filtering. As is suggested in [22], the least mean square and the minimum output energy algorithms present an ease implementation and analysis. As a future work, we suggest to focus on the complexity reduction of the proposed approach.

6. SIMULATION RESULTS

Simulation results analyze the performance of the proposed strategy considering the joint multicode MMSE and the joint ZF receivers, and the performance obtained from the conventional power control which assumes a bank of fixed rake receivers. We compare the different solutions by evaluating the total transmit (or mean transmit) power and the SIR (or mean SIR) at the mobile receiver.

Users are placed randomly in a hexagonal cell with radius $R = 1000$ m around the BS. The path-loss exponent is taken $\varsigma = 4$ and no shadowing is assumed. We consider a 6-path downlink channel. The target SIR is fixed at $\mathrm{SIR}_{\mathrm{target}} = 4$ (around 6 dB) for all simulations. We consider a number of $K = 20$ users, among them we have K', $K' < K$ multicode users. The spreading factor for the single-code users is $G_k = 128$ for any $k = K',\dots,K$. The multicode users has a spreading gain $G_{k'} = 64$, $k' = 1,\dots,K'$. We fix the user 1 as user of interest. We vary its number of allocated codes between $M_1 = 4$ and $M_1 = 64$.

In Figure 1, we plot the mean SIR, $(1/M_1)\sum_{m=1}^{M_1}\mathrm{SIR}(m)$, versus iteration index in the case of $M_1 = 4$ for the conventional power control algorithm (fixed rake receiver) and the proposed strategy which optimizes the joint MMSE and ZF multicode receiver coefficients. We note the one-iteration convergence of the multicode ZF receiver, the fast convergence of the multicode MMSE receiver, and the much slower convergence of the rake receiver.

In the case of $M_1 = 16$, the conventional rake receiver cannot meet the target SIR anymore, as shown in Figure 2, where we plot the variation of the $\mathrm{SIR}(m)$ on each code. However, the multicode receivers (ZF and MMSE) show good performance. Adding more virtual users brings the conventional receiver to even worse performance as is shown in Figure 3.

For $M_1 = 64$, the different lines for each receiver type correspond to the variation of the SIR on each code, $\mathrm{SIR}(m)$, versus iteration index.

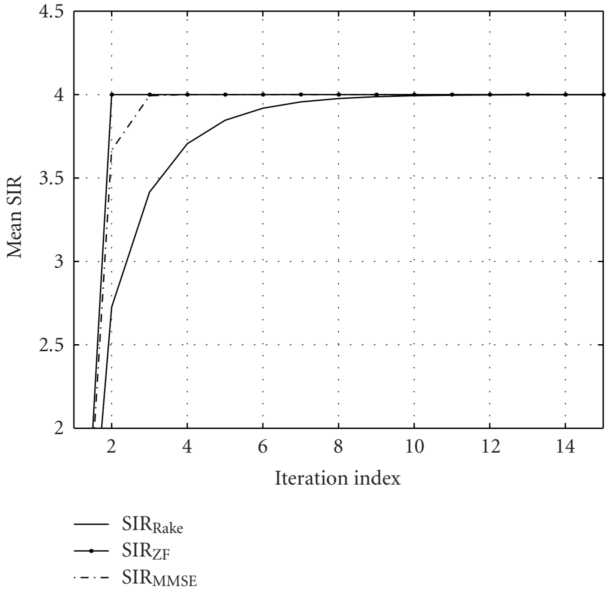


Figure 1: The SIR convergence for the rake, ZF, and MMSE receivers in the case $M_1 = 4$ multicode.

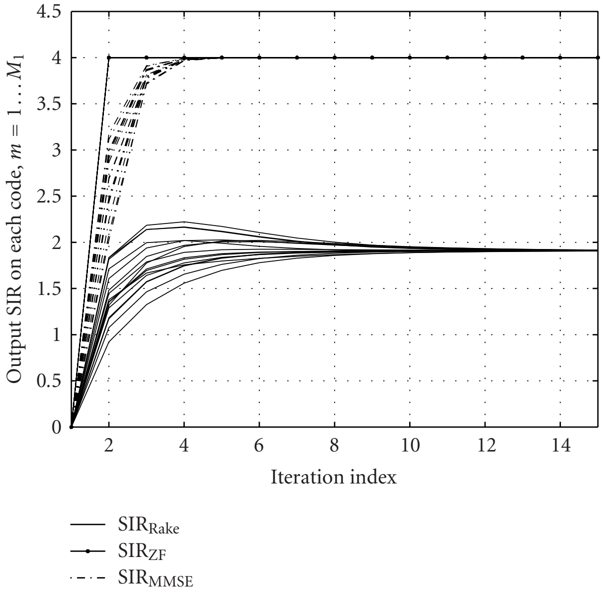


Figure 2: The SIR convergence for the rake, ZF, and MMSE receivers in the case $M_1 = 16$ multicode.

From Figures 2 and 3, we observe the difficulty of the conventional power control to reach the target SIR because of the MAI, ISI, and the intercode interferences. In the case of low load in the cell (few users), the conventional power control reaches the SIR target; see Figure 1. However, in this case, our proposed strategy presents a faster convergence.

The variation of the base station transmit power ratios $p_{\text{ZF}}/p_{\text{Rake}}$ and $p_{\text{MMSE}}/p_{\text{Rake}}$ versus the iteration index is shown in Figure 4 in the case of a number of codes $M_1 = 16$ codes of the multicode user. We note a decrease of about 20% of the transmitted BS power.

However, a much significant gain in transmitted BS power is noted in the case of $M_1 = 64$, as we can deduce from the results of Figure 5. The MMSE shows its optimality with significantly improved results with respect to the ZF receiver: the MMSE always gains power with respect to the rake receiver (the ratio is smaller than 1) where the ZF increases first the required power to achieve the required SIR.

We observe from Figures 4 and 5 that the proposed strategy of joint downlink power control and multicode receivers outperforms the conventional downlink power control in terms of total transmitted power of the multicode user.

In all simulations, we note the very fast (1 iteration) con vergence of the ZF receiver, the fast convergence of the MMSE receiver, and the much slower convergence of the conventional power control. The fast convergence of the ZF receiver is easy to explain: since this receiver performs an orthogonal projection into the subspace formed by the interfering signals, the output desired signal does not depend on the interfering signals' amplitudes. There is only one update of (21). In the case of the joint multicode MMSE receiver, at each iteration the receiver is updated since it depends on the received powers of each code. Finally, the rake receiver is a fixed receiver that takes into account only the desired signal processing the MAI, ISI, and intercode interferences as noise, therefore yielding the worst performance.

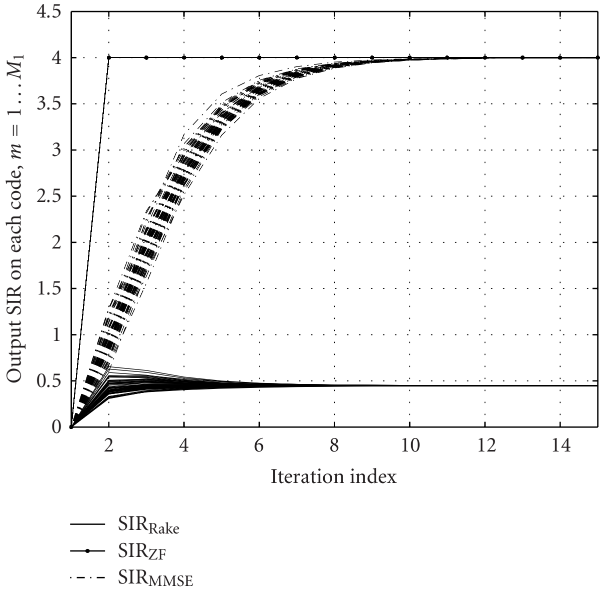


Figure 3: The SIR convergence for the rake, ZF, and MMSE receivers in the case $M_1 = 64$ multicode.

The best performance in minimizing transmit powers and maximizing the cell capacity is obtained by the MMSE receiver. The ZF receiver shows slightly lower performance, in terms of total transmit power, at high-cell loads (case of $M_1 = 64$, see Figure 5).

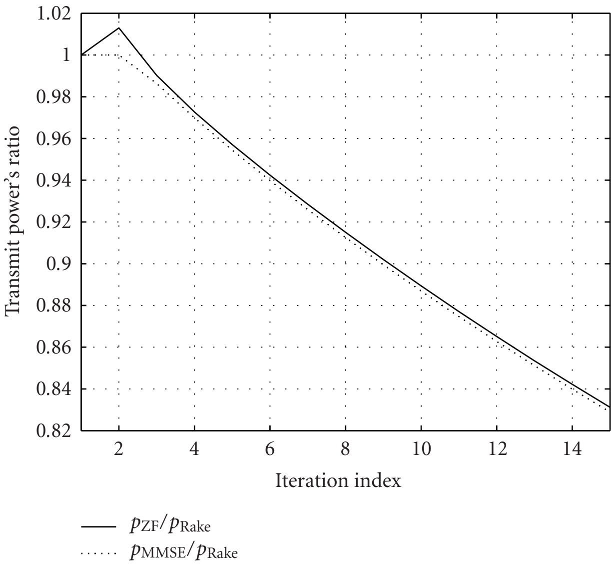


Figure 4: The mean total transmit powers ratio $p_{\mathrm{ZF}}/p_{\mathrm{Rake}}$ and $p_{\mathrm{MMSE}}/p_{\mathrm{Rake}}$ versus the iteration index for $M_1 = 16$.

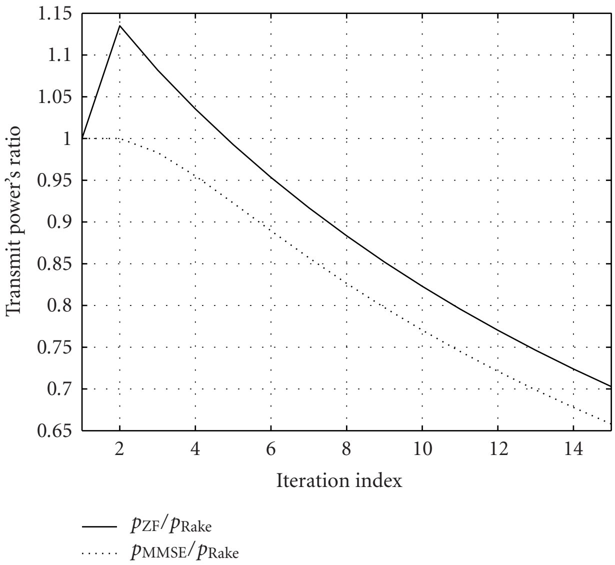


Figure 5: The mean total transmit power ratio $p_{\mathrm{ZF}}/p_{\mathrm{Rake}}$ and $p_{\mathrm{MMSE}}/p_{\mathrm{Rake}}$ versus the iteration index for $M_1 = 64$.

It should be noticed that at very low-cell loads (i.e., few interfering single-code users and few codes for the multicode user (case of $M_1 = 4$)) the three receivers show similar performance, a result that is expected.

After the convergence of the proposed strategy using a joint multicode MMSE receiver, the codes' power allocation is shown in Figure 6. As one can notice, it is not the same power per code. This confirms the interest of this power allocation-strategy for the downlink of the multicode user.

7. CONCLUSION

In this paper, we have analyzed the benefits of combining the downlink power control and the joint multicode detection for a multicode user. The proposed algorithm updates iteratively the transmitted code powers of the multicode users and the joint multicode receiver filter coefficients. We have used simulations to show the convergence and performance of the proposed algorithm in a system of practical interest. An important gain in transmit power reduction is obtained by implementing joint multicode detection. The performance of the ZF receiver allows an important reduction in computations (step 4 is avoided). The study of theoretical convergence of the proposed algorithm is under investigation based on the analysis proposed in [23].

In order to overcome the limitation of power control due to temporal filtering only, a joint power control and beamforming for wireless network is proposed in [17] where it is shown that a capacity increase is possible if array observations are combined in the MMSE sense. Therefore, as a direction for further research, the combination of the three basic interference cancelation approaches (transmit power control, multiuser detection, and beamforming) represents an ambitious challenge to be met by third-generation systems in order to provide high-capacity flexible services.

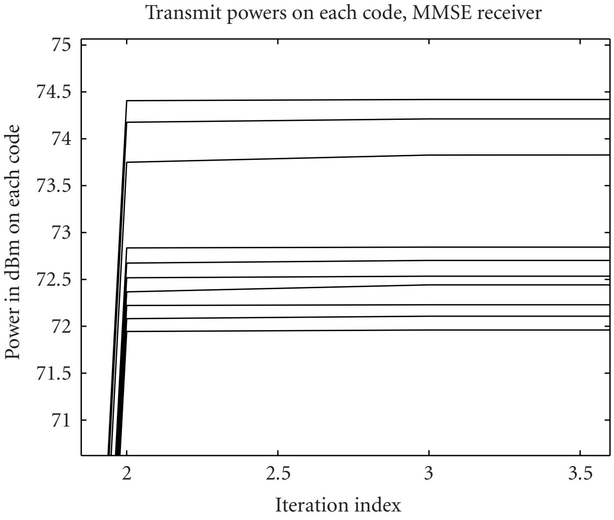


Figure 6: The code power allocation in the case of $M_1 = 10$ codes after convergence.

REFERENCES

[1] H. Holma and A. Toskala, Eds., *WCDMA for UMTS-Radio Access for Third Generation Mobile Communications*, John Wiley & Sons, New York, NY, USA, 2000.

[2] 3GPP TR 25.858 V5.0.0 (2002-03), "High Speed Downlink Packet Access: Physical layer aspects, (Release 5)".

[3] B. Sayadi and I. Fijalkow, "Joint detection for multicode transmission in downlink high speed UMTS," in *Proceedings of 60th IEEE Vehicular Technology Conference (VTC '04)*, vol. 2, pp. 837–840, Los Angeles, Calif, USA, September 2004.

[4] M. Saquib, R. D. Yates, and A. Ganti, "Power control for an asynchronous multirate decorrelator," *IEEE Transactions on Communications*, vol. 48, no. 5, pp. 804–812, 2000.

[5] R. D. Yates, "A framework for uplink power control in cellular radio systems," *IEEE Journal on Selected Areas in Communications*, vol. 13, no. 7, pp. 1341–1347, 1995.

[6] A. Sampath, P. S. Kumar, and J. M. Holtzman, "Power control and resource management for a multimedia CDMA wireless system," in *Proceedings of 6th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, Wireless: Merging onto the Information Superhighway (PIMRC '95)*, vol. 1, pp. 21–25, Toronto, Ontario, Canada, September 1995.

[7] V. V. Veeravalli and A. Sendonaris, "The coverage-capacity tradeoff in cellular CDMA systems," *IEEE Transactions on Vehicular Technology*, vol. 48, no. 5, pp. 1443–1450, 1999.

[8] L. C. Yun and D. G. Messerschmitt, "Variable quality of service in CDMA systems by statistical power control," in *Proceedings of IEEE International Conference on Communications, Gateway to Globalization*, vol. 2, pp. 713–719, Seattle, Wash, USA, June 1995.

[9] S. V. Hanly and D.-N. Tse, "Power control and capacity of spread spectrum wireless networks," *Automatica*, vol. 35, no. 12, pp. 1987–2012, 1999.

[10] G. J. Foschini and Z. Miljanic, "A simple distributed autonomous power control algorithm and its convergence," *IEEE Transactions on Vehicular Technology*, vol. 42, no. 4, pp. 641–646, 1993.

[11] S. Ulukus and R. D. Yates, "Adaptive power control with MMSE multiuser detectors," in *Proceedings of IEEE International Conference on Communications*, vol. 1, pp. 361–365, Montreal, Quebec, Canada, June 1997.

[12] J. G. Andrews, A. Agrawal, T. H. Meng, and J. M. Cioffi, "A simple iterative power control scheme for successive interference cancellation," in *Proceedings of 7th IEEE International Symposium on Spread Spectrum Techniques and Applications*, vol. 3, pp. 761–765, Prague, Czech Republic, September 2002.

[13] F. Meshkati, D. Guo, H. V. Poor, S. C. Schwartz, and N. B. Mandayam, "A unified approach to power control for multiuser detectors," in *Proceedings of the 2nd International Workshop on Signal Processing for Wireless Communications*, King's College, London, UK, June 2004.

[14] F. Meshkati, H. V. Poor, S. C. Schwartz, and D. Guo, "A unified power control algorithm for multiuser detectors in large systems: convergence and performance," in *Proceedings of the 43rd Allerton Conference on Communications, Control and Computing*, Urbana-Champaign, Ill, USA, September 2005.

[15] D. Guo and S. Verdú, "Randomly spread CDMA: asymptotics via statistical physics," *IEEE Transactions on Information Theory*, vol. 51, no. 6, pp. 1983–2010, 2005.

[16] F. Rashid-Farrokhi, K. J. Ray Liu, and L. Tassiulas, "Downlink power control and base station assignment," *IEEE Communications Letters*, vol. 1, no. 4, pp. 102–104, 1997.

[17] F. Rashid-Farrokhi, L. Tassiulas, and K. J. Ray Liu, "Joint optimal power control and beamforming in wireless networks using antenna arrays," *IEEE Transactions on Communications*, vol. 46, no. 10, pp. 1313–1324, 1998.

[18] J.-W. Lee, R. R. Mazumdar, and N. B. Shroff, "Downlink power allocation for multi-class wireless systems," *IEEE/ACM Transactions on Networking*, vol. 13, no. 4, pp. 854–867, 2005.

[19] L. Song and J. M. Holtzman, "CDMA dynamic downlink power control," in *Proceedings of 48th IEEE Vehicular Technology Conference (VTC '98)*, vol. 2, pp. 1101–1105, Ottawa, Ontario, Canada, May 1998.

[20] 3GPP TS 25.215 V6.3.0 (2005-06), "Physical Layer - Measurements (FDD), (Release 6)".

[21] A. Aguiar and J. Gross, "Wireless channel models," Tech. Rep. TKN-03-007, Telecommunications Networks Group, Technische Universität Berlin, Berlin, Germany, April 2003.

[22] C.-L. Wang, M.-H. Li, K.-M. Wu, and K.-L. Hwang, "Adaptive interference suppression with power control for CDMA systems," in *Proceedings of IEEE International Symposium on Circuits and Systems (ISCAS '01)*, vol. 4, pp. 286–289, Sydney, NSW, Australia, May 2001.

[23] J. Luo, S. Ulukus, and A. Ephremides, "Probability one convergence in joint stochastic power control and blind MMSE interference suppression," in *Proceedings of 37th Conference on Information Sciences and Systems*, The Johns Hopkins University, Baltimore, Md, USA, March 2003.

Bessem Sayadi received the B.S. Engineering degree in signal processing from the Ecole Supérieure des Télécommunications de Tunis (Sup'Com Tunis), Tunisia, in 1999, and both the M.Phil. (2000) and the Ph.D. (2003) degrees from the Signals and Systems Laboratory (LSS) at Supélec, Gif-sur-Yvette, the Paris XI University, Orsay, France. In 1999, he joined France Telecom where he was engaged in research on echo cancelation and adaptive filtering. He has also served as a Teaching Assistant in several courses on digital communications, signal processing, and electronics in the Department of Electronic and Electrical Engineering, SUPÉLEC, ENSEA, and University Parix IX, since September 2000. From 2003 to 2005, he was an Associate Researcher in the Image and Signal Processing Team (ETIS), at ENSEA, Cergy-Pontoise. In 2006, he joined France Telecom as a Research Engineer. His current research interests include Bayesian method, multiuser detection, video coding, radio resource management, IP-mobility, and cross-layer design.

Stefan Ataman received the B.S. and M.S. degrees from the Polytechnic University of Bucharest, Romania, in 1999 and 2000, respectively, and the Ph.D. degree from Université Paris-Sud, France, in 2004, all in electrical engineering. Currently, he is working as a Research Associate with University Cergy-Pontoise/ETIS laboratory, France. His research interests are in the areas of digital communications and signal processing with applications to CDMA wireless communications, power control, and multiuser receivers in CDMA cellular systems.

Inbar Fijalkow received her Engineering and Ph.D. degrees from Ecole Nationale Supérieure des Télécommunications (ENST), Paris, France, in 1990 and 1993, respectively. In 1993–1994, she was a Research Associate at Cornell University, NY, USA. In 1994, she joined ETIS, UMR 8051 (ENSEA - Cergy-Pontoise University - CNRS) in Cergy-Pontoise, France. Since 2004, she is the head of ETIS. Her current research interests are in signal processing applied to digital communications: iterative (turbo) processing (in particular turbo-equalization), analysis of communication systems (including

MIMO, OFDM, CDMA, etc.) and cross-layer optimization. Until 2005, she has been Member of the board of the GDR ISIS, which is the CNRS French national research group on signal, image, and vision processing. She has been an Associate Editor of the IEEE Transactions on Signal Processing 2000–2003.

EURASIP JOURNAL ON WIRELESS COMMUNICATIONS AND NETWORKING

Special Issue on

Trust and Digital Rights Management in Wireless Multimedia Networks and Systems

Call for Papers

With the widespread infusion of digital technologies and the ensuing ease of digital content transport over the Internet, multimedia data distribution is experiencing exponential growth. The use of emerging technologies and systems based on wireless networks has further facilitated the ubiquitous presence of multimedia data. These rapid advances are neither without cost nor without negative impact. With the increasing sophistication and ubiquity of sharing and dissemination of data over a plethora of networks, the complexity and challenges of untrustworthy behavior as well as cyber attacks may grow significantly. Moreover, the emerging unstructured, mobile, and ad hoc nature of today's heterogeneous network environment is leading to problems such as the exploitation of resources due to selfish and malicious behavior by users and their agents in the networks.

Trust and digital rights management (DRM) of data and the underlying systems and networks have therefore become of critical concern. Moreover, satisfying users' quality of service (QoS) requirements while implementing trust and DRM mechanisms may overburden the already resourceconstrained wireless networks.

The objective of this solicitation is to encourage cuttingedge research in trust and digital rights management in wireless networks and systems. Dissemination of research results in formulating the trust and DRM issues, and emerging solutions in terms of technologies, protocols, architecture, and models are expected to contribute to the advancement of this field in a significant way. Topics of interests include but are not limited to:

- DRM issues (copyright protection, tracking, tracing, fingerprinting, authentication, concealment, privacy, access control, etc.) in wireless multimedia
- Wireless multimedia traffic modeling, analysis, and management
- Tradeoff between QoS, security, dependability, and performability requirements
- Context, behavior, and reputation specification, modeling, identification, and management
- Trust and DRM models, architectures, and protocols
- Trust and DRM in applications (telemedicine, ubiquitous commerce, etc.)
- Trust and DRM in wireless ad hoc, mesh, sensor and heterogeneous networks
- Trust and DRM technologies for wireless multimedia (digital watermarking, encryption, coding, and compression, and their interplay)
- Test beds for experimental evaluation of trust and DRM models.

Authors should follow the EURASIP JWCN manuscript format described at http://www.hindawi.com/journals/wcn/. Prospective authors should submit an electronic copy of their complete manuscript through the EURASIP JWCN manuscript tracking system at http://www.hindawi.com/mts/, according to the following timetable:

Manuscript Due	December 1, 2006
Acceptance Notification	April 1, 2007
Final Manuscript Due	June 1, 2007
Publication Date	4th Quarter, 2007

GUEST EDITORS:

Farid Ahmed, Department of Electrical Engineering and Computer Science The Catholic University of America, Washington, DC, 20064, USA; ahmed@cua.edu

Mohamed Eltoweissy, The Bradley Department of Electrical and Computer Engineering, Virginia Tech, Advanced Research Institute, Arlington, VA 22203, USA; toweissy@vt.edu

Kamesh Namuduri, Department of Electrical and Computer Engineering Wichita State University, Wichitan KS 67260, USA; kamesh.namuduri@wichita.edu

Hindawi Publishing Corporation
http://www.hindawi.com

GUEST EDITORS:

Leonel Sousa, INESC-ID, IST, Universidade Técnica de Lisboa, 1000-029 Lisboa, Portugal; las@inesc-id.pt

Noel O'Connor, School of Electronic Engineering, Dublin City University, Glasnevin, Dublin 9, Ireland; noel.oconnor@eeng.dcu.ie

Marco Mattavelli, Signal Processing Laboratory, Ecole Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland; marco.mattavelli@epfl.ch

Antonio Nunez, IUMA, Universidad de Las Palmas de Gran Canaria, 35017 Las Palmas de Gran Canaria, Spain; nunez@iuma.ulpgc.es

EURASIP JOURNAL ON WIRELESS COMMUNICATIONS AND NETWORKING

Special Issue on Multimedia over Wireless Networks

Call for Papers

Scope

In recent years there has been a tremendous increase in demand for multimedia delivered over wireless networks. The design and capabilities of the mobile devices and the services being offered reflect the increase in multimedia usage in the wireless setting. Applications that are in the process of becoming essential to users include video telephony, gaming, or TV broadcasting. This trend creates great opportunities for identifying new wireless multimedia applications, and for developing advanced systems and algorithms to support these applications. Given the nature of the channel and of the mobile devices, issues such as scalability, error resiliency, and energy efficiency are of great importance in applications involving multimedia transmission over wireless networks.

The papers in this issue will focus on state-of-the-art research on all aspects of wireless multimedia communications. Papers showing significant contributions are solicited on topics including but are not limited to:

- Error resilience and error concealment algorithms
- Rate control for wireless multimedia coding
- Scalable coding and transmission
- Joint source-channel coding
- Joint optimization of power consumption and rate-distortion performance
- Wireless multimedia traffic modeling
- Wireless multimedia streaming
- Wireless multimedia coding
- QoS for wireless multimedia applications
- Distributed multimedia coding

Authors should follow the EURASIP Journal on Wireless Communications and Networking manuscript format described at http://www.hindawi.com/journals/wcn/. Prospective authors should submit an electronic copy of their complete manuscript through the EURASIP Journal on Wireless Communications and Networking's Manuscript Tracking System at http://www.hindawi.com/mts/, according to the following timetable:

Manuscript Due	March 1, 2007
Acceptance Notification	July 1, 2007
Final Manuscript Due	October 1, 2007
Publication Date	4th Quarter, 2007

GUEST EDITORS:

Dan Lelescu, R&D lab, Imaging Division, Micron Technology, Inc., 2125 O'Nel Drive, San Jose, CA 9513, USA;
danlelescu@yahoo.com

Peter Schelkens, Deptartment of Electronics and Information Processing (ETRO), Vrije Universiteit Brussel (VUB), Pleinlaan 2, 1050 Brussel, Belgium;
Peter.Schelkens@vub.ac.be

Kameswara Rao Namuduri, Deptartment of Electrical and Computer Engineering, Wichita State University, 1845 Fairmount, Wichita, 67260 KS, USA;
kamesh.namuduri@wichita.edu

EURASIP JOURNAL ON WIRELESS COMMUNICATIONS AND NETWORKING

Special Issue on

Cognitive Radio and Dynamic Spectrum Sharing Systems

Call for Papers

Aims and Scope of the Special Issue

The ever-growing need for wireless communications which provide high data rates entails a substantial demand for new spectral resources and more flexible and efficient use of existing resources. Several measurement campaigns conducted in the recent years show that frequency spectrum in the range 30 MHz-3 GHz is most of the time unused leading to low average occupancy rates and motivating to allow more flexible spectrum use. Promising solution to exploit spectrum in a flexible way is via cognitive radio and dynamic spectrum sharing systems which use innovative spectrum management and allow different systems to share the same frequency band. Significant potential improvements offered with such approaches and also positive view from regulatory bodies have led to exploding interest in this field recently. However, such paradigm shift introduces many new design challenges that have to be solved in order to enable proper functioning of the spectrum sharing and cognitive radio systems. Recent research efforts include considerations of different physical layer technologies, spectrum sensing, coexistence mechanisms between legacy and secondary users, and shared medium access among many secondary users.

The objective of this special issue is to showcase the most recent developments and research in this field, as well as to enhance its state-of-the-art. Original and tutorial articles are solicited in all aspects of cognitive radio and spectrum sharing including system and network protocol design, enabling technologies, theoretical studies, practical applications, and experimental prototypes.

Topics of Interest:

Topics of interest include, but are not limited to:

- Spectrum measurements and current usage
- Spectrum regulations
- Spectrum sensing and awareness techniques
- Dynamic spectrum management
- Capacity and achievable data rates in cognitive radio
- Multiuser spectrum sharing:
  - Priority resource allocation
  - Cooperation and competition of users
  - Auction-based spectrum sharing
- Coexistence of spectrum sharing and legacy narrowband systems
- Physical layer design of spectrum sharing systems:
  - OFDM, OQAM, UWB, CDMA, SDR
  - MIMO component in spectrum sharing
- Applications of cognitive radio & spectrum sharing
- Standardization of cognitive radio and spectrum sharing: IEEE P1900, IEEE 802.22, ITU-R activities

Authors should follow the JWCN manuscript format at http://www.hindawi.com/journals/WCN. Prospective authors should submit an electronic copy of their complete manuscript through the JWCN's Manuscript Tracking System at http://www.hindawi.com/mts/, according to the following timetable:

Manuscript Due	June 1, 2007
Acceptance Notification	October 1, 2007
Final Manuscript Due	January 1, 2008
Publication Date	1st Quarter, 2008

GUEST EDITORS:

Ivan Cosovic, DoCoMo Communications Laboratories Europe GmbH, 80687 Munich, Germany;
cosovic@docomolab-euro.com

Friedrich K. Jondral, Institut für Nachrichtentechnik, Universität Karlsruhe (TH), 76128 Karlsruhe, Germany ; jondral@int.uni-karlsruhe.de

Milind M. Buddhikot, Bell Laboratories, Lucent Technologies, Holmdel, NJ 07733-3030, USA; mbuddhikot@lucent.com

Ryuji Kohno, Division of Physics, Electrical & Computer Engineering, Yokohama National University, Yokohama 240-8501, Japan; kohno@ynu.ac.jp

Hindawi Publishing Corporation
http://www.hindawi.com

INTERNATIONAL JOURNAL OF ANTENNAS AND PROPAGATION

Special Issue on Radio Frequency Identification

Call for Papers

The International Journal of Antenna and Propagation (IJAP) is publishing a special issue on radio frequency identification (RFID) technologies. RFID systems are used for electronically identifying, locating, and tracking products, animals, vehicles. Passive tags (transponders) do not have a battery and have limited range, typically about one meter. Active tag systems have a power source and much longer range. Current RFID research and development include theory, antenna design, wireless communication, networking, system-on-chip IC development, database management, propagation theory, signal processing, embedded system design, and more.

This special issue is to present new RFID-related techniques to address theoretical and technical implementation challenges

Papers that reflect the current and future methods are solicited.

Topics of interest include (but are not limited to):

- Reader and tag antennas
- Metallic object tag antenna design
- RF- and antenna-related techniques to improve the recognition rate of RFID
- Miniaturization of tag antenna
- Reading range for different antennas
- RFID measurements and modeling
- Printable tag design and analysis
- Active and passive tag antennas
- Location technologies
- RFID near-field and far-field analyses
- RFID impedance matching and related topics
- Smart label tag antennas
- RFID and USN system (ubiquitous sensor network)

Authors should follow International Journal of Antennas and Propagation manuscript format described at the journal site http://www.hindawi.com/journals/ijap/. Prospective authors should submit an electronic copy of their complete manuscript through International Journal of Antennas and Propagation Manuscript Tracking System at http://www.hindawi.com/mts/, according to the following timetable:

Manuscript Due	March 1, 2007
Acceptance Notification	July 1, 2007
Final Manuscript Due	October 1, 2007
Publication Date	1st Quarter, 2008

GUEST EDITORS:

Youchung Chung, Department of Information and Communication Engineering, Daegu University, Gyeongsan, Gyeongbuk 712-714, South Korea; youchung@daegu.ac.kr

Manos Tentzeris, School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0250, USA; etentze@ece.gatech.edu

Pavel Nikitin, Intermec Technologies Corporation, 6001 36th Avenue West, Everett, WA 98203-1264, USA; pavel.nikitin@intermec.com

Junho Yeo, System Research Team, Electronics and Telecommunications Research Institute, 161 Gajeong-Dong, Yuseong-Gu, Daejeon 305-700, South Korea; jyeo@etri.re.kr

Jin Mitsugi, Auto-ID Labs, Keio Research Institute at Shonan-Fujisawa Research Support Center (SFC), Keio University, 5322 Endo, Fujisawa 252-8520, Japan; mitsugi@sfc.wide.ad.jp

Markku Kivikoski, Institute of Electronics, Tampere University of Technology, 33101 Tampere, Finland; markku.kivikoski@tut.fi

Hans-Erik Nilsson, Depatment of Information Technology and Media, Mid Sweden University, 851 70 Sundsvall, Sweden; hans-erik.nilsson@miun.se

Zhi Ning Chen, Radio Systems Department, Communications Division, Institute for Infocomm Research, Singapore 119613; chenzn@i2r.a-star.edu.sg

Hindawi Publishing Corporation
http://www.hindawi.com

INTERNATIONAL JOURNAL OF ANTENNAS AND PROPAGATION

Special Issue on Ultra-Wideband Antennas

Call for Papers

"Over the last few years much has been published about the principles and applications of electromagnetic waves with large relative bandwidth, or nonsinusoidal waves for short. The next step is the development of the technology for the implementation of these applications. It is generally agreed that the antennas pose the most difficult technological problem."

Henning F. Harmuth,
Antennas and Waveguides for Nonsinusoidal Waves,
Academic Press, New York, 1984, p. xi.

More than twenty years after Harmuth's observations on the difficulties posed by UWB antenna design and five years after the FCC authorized ultra-wideband (UWB) systems, a variety of UWB products is nearing wide-scale commercialization. Antenna designers and engineers have solved the UWB antenna problem in many ways, yielding compact antennas well-suited for a variety of applications. Unlike in previous decades when UWB antenna progress came in fits and spurts, today there is an active and growing community of UWB antenna designers sharing their insights and designs at professional conferences, trade shows, and in the pages of technical journals. The time is ripe for a special issue on UWB antennas that captures this progress and provides insight to where UWB antenna design will go in the future.

UWB systems have opened up new dimensions of antenna design. Antennas have become an organic part of RF systems, providing filtering and other custom-designed frequency-dependent properties. The wide bandwidths of UWB antennas present new challenges for design, simulation, and modeling. Optimizing UWB antennas to meet the demands of UWB propagation channels is similarly challenging. And as always, consumer applications demand compact and aesthetically pleasing designs that must nevertheless perform. Designers are meeting these challenges with novel antenna designs and novel materials. Designers are also using concepts like polarization diversity, directivity arrays, and electric-magnetic element combinations.

The goal of this special issue is to present the state of the art in UWB antenna engineering and to address the many ways in which UWB antenna designers are understanding and meeting the challenges of UWB design. Topics of interest include (but are by no means limited to):

- UWB antennas, including analysis, design, development, measurement, and testing
- Novel types of UWB antennas
- Adaptations of well-known UWB antennas that yield novel results
- Novel materials for use with UWB antennas
- Applications of UWB antennas
- Design and simulation techniques for UWB antennas and UWB propagation
- Safety and public policy related to UWB antennas and propagation
- UWB propagation channels
- Measurement methods for UWB antennas and propagation
- Challenges and anticipated needs in UWB antennas and propagation research and development
- History of UWB antennas and their development.

Authors should follow International Journal of Antennas and Propagation manuscript format described at the journal site http://www.hindawi.com/journals/ijap/. Prospective authors should submit an electronic copy of their complete manuscript through International Journal of Antennas and Propagation's Manuscript Tracking System at http://www.hindawi.com/mts/, according to the following timetable:

Manuscript Due	May 1, 2007
Acceptance Notification	September 1, 2007
Final Manuscript Due	December 1, 2007
Publication Date	1st Quarter, 2008

GUEST EDITORS:

James Becker, Microwave and Millimeter Wave Electronics Lab, Department of Electrical and Computer Engineering, Montana State University, Bozeman, MT 59717, USA; jbecker@ece.montana.edu

Dejan Filipovic, Department of Electrical and Computer Engineering, University of Colorado at Boulder, Boulder, CO 80309-0425, USA; dejan.filipovic@colorado.edu

Hans Schantz, The Q-Track Corporation, Huntsville, AL 35816, USA; h.schantz@q-track.com

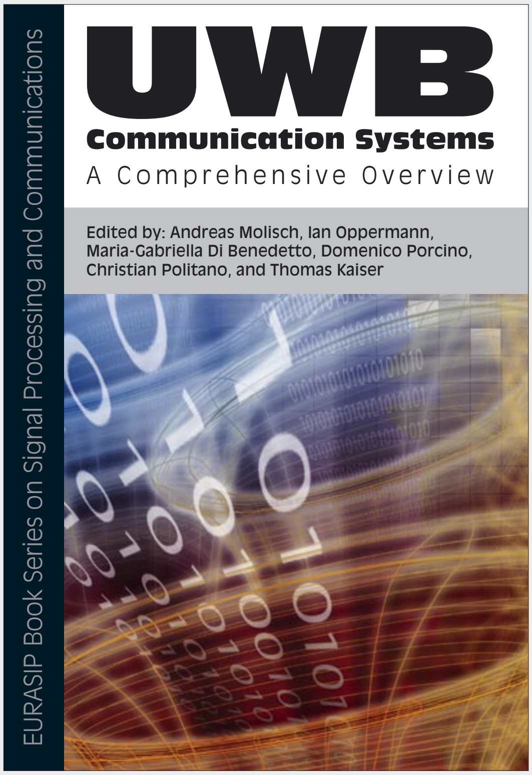
Seong-Youp Suh, Intel Corporation, Santa Clara, CA 95052, USA; seong-youp.suh@intel.com

Hindawi Publishing Corporation
http://www.hindawi.com

EURASIP Book Series on Signal Processing and Communications

UWB Communication Systems—A Comprehensive Overview

Edited by: Andreas Molisch, Ian Oppermann, Maria-Gabriella Di Benedetto, Domenico Porcino, Christian Politano, and Thomas Kaiser



EURASIP Book Series on Signal Processing and Communications

UWB

Communication Systems

A Comprehensive Overview

Edited by: Andreas Molisch, Ian Oppermann, Maria-Gabriella Di Benedetto, Domenico Porcino, Christian Politano, and Thomas Kaiser

Ultra-wideband (UWB) communication systems offer an unprecedented opportunity to impact the future communication world.

The enormous available bandwidth, the wide scope of the data rate/range trade-off, as well as the potential for very-low-cost operation leading to pervasive usage, all present a unique opportunity for UWB systems to impact the way people and intelligent machines communicate and interact with their environment.

The aim of this book is to provide an overview of the state of the art of UWB systems from theory to applications.

Due to the rapid progress of multidisciplinary UWB research, such an overview can only be achieved by combining the areas of expertise of several scientists in the field.

More than 30 leading UWB researchers and practitioners have contributed to this book covering the major topics relevant to UWB. These topics include UWB signal processing, UWB channel measurement and modeling, higher-layer protocol issues, spatial aspects of UWB signaling, UWB regulation and standardization, implementation issues, and UWB applications as well as positioning.

The book is targeted at advanced academic researchers, wireless designers, and graduate students wishing to greatly enhance their knowledge of all aspects of UWB systems.

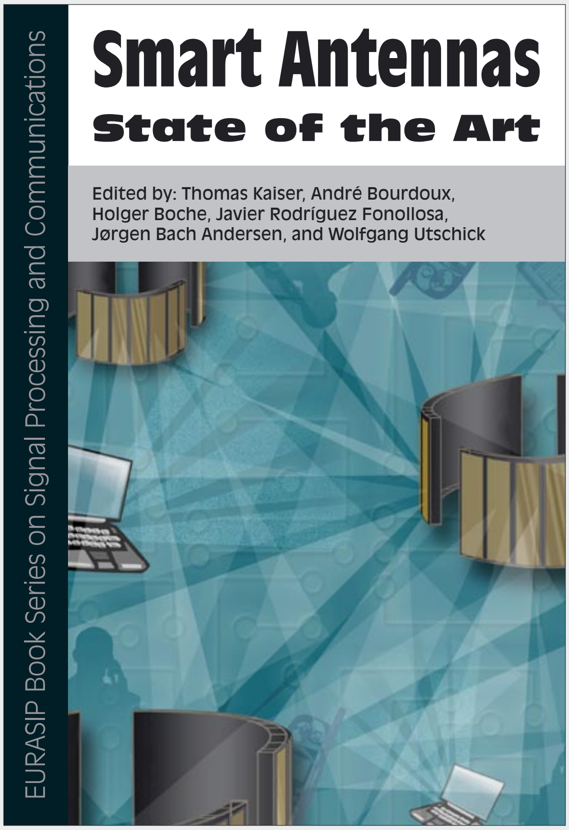
For any inquiries on how to order this title please contact books.orders@hindawi.com

The EURASIP Book Series on Signal Processing and Communications publishes monographs, edited volumes, and textbooks on Signal Processing and Communications. For more information about the series please visit: http://hindawi.com/books/spc/about.html

EURASIP Book Series on Signal Processing and Communications

SMART ANTENNAS—STATE OF THE ART

Edited by: Thomas Kaiser, André Bourdoux, Holger Boche,
Javier Rodríguez Fonollosa, Jørgen Bach Andersen, and Wolfgang Utschick


EURASIP Book Series on Signal Processing and Communications

Smart Antennas
State of the Art

Edited by: Thomas Kaiser, André Bourdoux,
Holger Boche, Javier Rodríguez Fonollosa,
Jørgen Bach Andersen, and Wolfgang Utschick

Smart Antennas—State of the Art brings together the broad expertise of 41 European experts in smart antennas. They provide a comprehensive review and an extensive analysis of the recent progress and new results generated during the last years in almost all fields of smart antennas and MIMO (multiple input multiple output) transmission. The following represents a summarized table of content.

Receiver: space-time processing, antenna combining, reduced rank processing, robust beamforming, subspace methods, synchronization, equalization, multiuser detection, iterative methods

Channel: propagation, measurements and sounding, modeling, channel estimation, direction-of-arrival estimation, subscriber location estimation

Transmitter: space-time block coding, channel side information, unified design of linear transceivers, ill-conditioned channels, MIMO-MAC srategies

Network Theory: channel capacity, network capacity, multihop networks

Technology: antenna design, transceivers, demonstrators and testbeds, future air interfaces

Applications and Systems: 3G system and link level aspects, MIMO HSDPA, MIMO-WLAN/UMTS implementation issues

This book serves as a reference for scientists and engineers who need to be aware of the leading edge research in multiple-antenna communications, an essential technology for emerging broadband wireless systems.

For any inquiries on how to order this title please contact books.orders@hindawi.com

The EURASIP Book Series on Signal Processing and Communications publishes monographs, edited volumes, and textbooks on Signal Processing and Communications. For more information about the series please visit: http://hindawi.com/books/spc/about.html

3DTV CONFERENCE 2007

THE TRUE VISION - CAPTURE, TRANSMISSION AND DISPLAY OF 3D VIDEO

May 7-9, 2007, KICC Conference Center, Kos Island, Greece

General Chairs
Georgios Triantafyllidis
Centre for Research and Technology Hellas, GR
Levent Onural,
Bilkent University, TR

Technical Chairs
Aljoscha Smolic,
Fraunhofer Gesellschaft, DE
Jörn Ostermann
Leibniz University of Hannover, DE
John Watson
University of Aberdeen, UK
Reha Civanlar
Koc University, TR
Thomas Sikora,
Technical University of Berlin, DE

Finance Chair
Nikos Grammalidis
Centre for Research and Technology Hellas, GR

Publication Chair
Xenophon Zabulis
Centre for Research and Technology Hellas, GR

Publicity Chair
Atanas Gotchev
Tampere University of Technology, FI

Industry Liaison
Ismo Rakkolainen
FogScreen, FI

American Liaison
Yiannis Aloimonos
University of Maryland, US

Special Sessions and Tutorials Chair
Aydin Alatan
METU, TR

Webmaster
Georgios Litos
Centre for Research and Technology Hellas, GR

First Call For Papers

Creating exact 3D moving images as ghost-like replicas of 3D objects has been an ultimate goal in video science. Capturing 3D scenery, processing the captured data for transmission, and displaying the result for 3D viewing are the main functional components. These components encompass a wide range of disciplines: imaging and computer graphics, signal processing, telecommunications, electronics, optics and physics are needed.

The objective of the **3DTV-Conference** is to bring together researchers and developers from academia and industry with diverse experience and activity in distinct, yet complementary, areas so that full scale 3D video capabilities are seemlessly integrated.

Topics of Interest

3D Capture and Processing
- 3D time-varying scene capture technology
- Multi-camera recording
- 3D photography algorithms
- Synchronization and calibration of camera arrays
- 3D view registration
- Multi-view geometry and calibration
- Holographic camera techniques
- 3D motion analysis and tracking
- Surface modeling for 3-D scenes
- Multi-view image and 3D data processing

3D Transmission
- Systems, architecture and transmission aspects of 3D
- 3D streaming
- Error-related issues and handling of 3d video
- Hologram compression
- Multi-view video coding
- 3D mesh compression
- Multiple description coding for 3D
- Signal processing for diffraction and holographic 3DTV

3D Visualization
- 3D mesh representation
- Texture and point representation
- Object-based representation and segmentation
- Volume representation
- 3D motion animation
- Dense stereo and 3D reconstruction
- Stereoscopic display techniques
- Holographic display technology
- Reduced parallax systems and integral imaging
- Underlying optics and VLSI technology
- Projection and display technology for 3D videos
- Human factors

3D Applications
- 3D imaging in virtual heritage and virtual archaeology
- 3D Teleimmersion and remote collaboration
- Augmented reality and virtual environments
- 3D television, cinema, games and entertainment
- Medical and biomedical applications
- 3D Content-based retrieval and recognition
- 3D Watermarking

Paper Submission

Prospective contributors are invited to submit full papers electronically using the on-line submission interface, following the instructions available at http://www.3dtv-con.org. Papers should be in Adobe PDF format, written in English, with no more than four pages including figures, using a font size of 11. Conference proceedings will be published online by the IEEE.

Important Dates

1 December 2006	Special sessions and tutorials proposals
15 December 2006	Regular Paper submission
9 February 2007	Notification of acceptance
2 March 2007	Submission of camera-ready papers

3DTV NoE
ITI-CERTH
Information Society Technologies
Institute of Electrical and Electronics Engineers
European Association for Signal and Image Processing

The International ITG / IEEE Workshop on Smart Antennas
WSA 2007
February 26-27, 2007
Vienna

Call for Papers

The International ITG / IEEE Workshop on Smart Antennas WSA 2007 provides a forum for presentation of the most recent research on smart antennas. The objective is to continue, accelerate, and broaden the momentum already gained with a series of ITG Workshops held since 1996: Munich and Zurich'96, Vienna and Kaiserslautern'97, Karlsruhe' 98, Stuttgart'99, Ilmenau'01, Munich'04, Duisburg'05, and Ulm'06. This call for papers intends to solicit contribu-tions on latest research of this key technology for wireless communication systems.

Workshop topics include, but are not limited to:

- Antennas for beamforming and diversity
- Channel measurements
- Spatial channel modeling
- Beamforming
- Diversity concepts
- Space-time processing
- Space-time codes
- MIMO Systems
- Multicarrier MIMO
- Multiuser MIMO
- Cooperative and sensor networks
- Crosslayer optimisation
- Radio resource management
- Cellular systems
- Link, system and network level simulations
- Hard- and software implementation issues

There will be oral as well as poster presentations.
The workshop will be jointly organized by the Institute of Communications and Radio Frequency at Vienna University of Technology and the ftw. Telecommunications Research Center Vienna in cooperation with the VDE, ÖVE, and the IEEE on February 26-27, 2007 in Vienna, Austria

Organizers and Workshop Chairs

Markus Rupp,
E-Mail: mrupp@nt.tuwien.ac.at
Christoph Mecklenbräuker,
E-Mail: cfm@ftw.at
Information about the workshop can soon be found at: http://www.ftw.at/

Technical program committee

Jørgen Bach-Andersen
Sergio Barbarossa
Ezio Biglieri
Holger Boche

Helmut Bölcskei
Ernst Bonek
Andreas Czylwik
Armin Dekorsy
Gerhard Fettweis
Bernard H. Fleury
Javier Fonollosa
Alex Gershman

David Gesbert
Martin Haardt
Dirk Heberling
Ari Hottinen

Thomas Kaiser
Anja Klein
Miguel Lagunas
Geert Leus
Jürgen Lindner
Gerald Matz
Utz Martin
Tadashi Matsumoto

Michael Meurer
Werner Mohr
Ralf Müller
Josef A. Nossek

Björn Ottersten
Steffen Paul
Ana I. Pérez-Neira
Arpad L. Scholtz
Nikos Sidiropoulos
Klaus Solbach
Michael Tangemann
Giorgio Taricco

Werner Teich
Reiner Thomä
Wolfgang Utschick
Alle-Jan van der Veen

Mats Viberg
Emanuele Viterbo
Tobias Weber
Joachim Wehinger
Werner Wiesbeck
Thomas Zemen
Abdelhak Zoubir

CALL FOR PAPERS
3rd IET/EURASIP Conference on

DSP *enabled* Radio

Glasgow, Scotland, UK
13th/14th September 2007
`http://www.DSPenabledRadio.org`

In the past decade, digital signal processing (DSP) algorithms and architectures for baseband processing have brought applications such as 3G mobile communications and wireless LAN to mass markets. Since then, further progress in DAC and ADC technology has permitted DSP to be applied at IF sampling rates up to several 100 MHz, which has opened up a large range of advanced DSP algorithms to be deployed for – potentially reconfigurable – communications system functions such as modulation, synchronisation, equalisation, coding, and many more. This development is expected to continue, and opportunities such as software defined radio (SDR) architectures forming the basis for cognitive radios for improved spectrum efficiency and reliable and ubiquitous communication are likely to become reality within the next couple of years.

This 2 day event forms a continuation of two previous conferences of identical title held in Livingston, Scotland, in 2003, and in Southampton in 2005, which were each attended by more than 120 international researchers and industrialist. Both events were co-sponsored by the Institution of Engineering and Technology (IET — formerly the Institution of Electrical Engineers, IEE) and the European Association for Signal Processing (EURASIP). This third conference IET/EURASIP will comprise of an invited keynote speaker, a number of invited contributions on key topics, oral presentations, poster sessions, and a small industrial exhibition for companies demonstrating the latest hardware and software for DSP enabled radio. Prospective authors are invited to submit original contributions on all aspects of DSP enable radio, including, but not limited to:

- hardware platforms
- mixed signal techniques
- application case studies
- sample rate conversion
- RF and IF processing
- ultra-wideband radio
- standards, IEEE802.1x
- SDR implementation
- FPGA architectures
- system-on-chip
- rapid prototyping
- cognitive radio
- power control
- RF linearisation
- Tx/Rx beamforming
- MIMO systems
- algorithms and architecture
- digital up/downconversion
- standards and inter-operability
- emerging standards: WiMAX etc
- synchronisation and equalisation
- equalisation / channel estimation
- beamforming/smart antennas
- wireless sensor / ad-hoc networks

Papers will be reviewed on the basis of a two page extended abstract of sufficient detail to permit reasonable evaluation. The deadline for submission is June 29, 2007, with notification of decision by July 20, 2007. Accepted papers will be edited into a bound digest of the event, available on CD, and be included in IEEExplore. The cover page of the summary should include paper title, names of authors and their affiliation, as well as the complete address, telephone numbers and e-mail of the corresponding author.

Detailed information on the extended abstract and paper submission, technical program, accommodation, and travel will be posted on the conference web site `http://www.DSPenabledRadio.org`.

Bob Stewart, General Chair
Stephan Weiss and Eugen Pfann, Technical Co-Chairs
Dept. of Electronic & Electrical Engineering
University of Strathclyde
Glasgow G1 1XW, Scotland, UK
`{r.stewart,s.weiss,e.pfann}@eee.strath.ac.uk`

R F I D
2 0 0 7

The First International
EURASIP Workshop on RFID Technology

RFID 2007

24 - 25 September 2007, Vienna, Austria

Call for Papers

The first international EURASIP workshop on RFID technology will provide a premium forum for presentation of the most recent research in this new technology. The objective is to continue, accelerate, and broaden the momentum already gained in this field. This call for papers intends to solicit contributions on the latest research of this new technology for wireless communication systems, spanning from the individual tag to entire systems based on RFIDs.

Internet page
http://rfid07.ftw.at

Important Dates

Paper submission	**31. May 2007**
Author notification	02. July 2007
Final manuscript due	19. July 2007

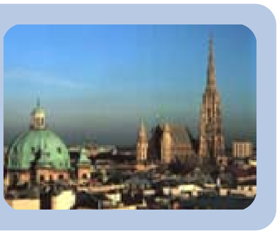
Organizing Committee
Markus Rupp, TU Vienna
Holger Arthaber, TU Vienna
Pavle Belanović, ftw.

Technical Program Committee
Gildas Avoine, MIT
Georg Brasseur, TU Graz
Elgar Fleisch, ETH Zurich
Heyno Garbe, U. of Hannover
Bernard Jakoby, U. of Linz
Dimitris Kiritsis, EPFL
Otto Koudelka, TU Graz
Gottfried Magerl, TU Vienna
Christoph Mecklenbräuker, TU Vienna
Gerald Ostermayer, FH Hagenberg
Ludger Overmeyer, U. of Hannover
Wolfgang Pribyl, TU Graz
Markus Rupp, TU Vienna
Arpad L. Scholtz, TU Vienna
Andreas Springer, U. of Linz
Robert Weigel, U. of Erlangen-Nuremberg
Klaus Witrisal, TU Graz
Johannes Wolkerstorfer, TU Graz
Horst Zimmerman, TU Vienna

Workshop topics include, but are not limited to:
- Electromagnetic field measurements
- Antenna design
- Multiple antenna systems
- Modulation schemes for RFID
- Security and privacy issues
- Link, system, and network level simulations
- Hardware and software implementation issues
- Inductive coupling for DC supply
- Multi-frequency and broadband tags
- Smart tags, programmable tags, and embedded systems
- Sensor tags and RFID for asset tracking and localization
- Advances in passive long range RFID technology
- Manufacturing processes for RFID tags
- Applications and industrial experience

Submission Guidelines
Authors are encouraged to submit original, unpublished work for presentation at the workshop in the form of posters and full papers. Acceptance shall be based on an extended abstract of two pages in the standard IEEE conference format.

Workshop Venue
The workshop will be held in Vienna, Austria, at the Telecommunications Research Center Vienna (ftw.).



IEEE AUSTRIA SECTION
CHRISTIAN DOPPLER FORSCHUNGSGESELLSCHAFT
EURASIP
GIT
ftw.