

# **Open Postdoc position at EURECOM's Communication Theory Group**

## **Title: Distributed cooperation in interference-limited wireless networks**

### **Background**

Recent research on cooperative communications has revealed that tools from MIMO theory, and more generally spatial processing, are instrumental in reaching the upper limits of capacity in large and dense networks [1]. Indeed an ideal bound on the capacity can be envisioned by treating every transmitting/receiving node of the network as an element in a huge distributed MIMO array of antenna, thus exhibiting maximum spatial processing related gains: Diversity, multiplexing, beamforming and interference mitigation gains. In this setup, the denser the network gets, the more spatial degrees of freedom are left for use in its optimization.

However, the ideal MIMO bounds and techniques are not applicable as is in real-life networks: First, devices (especially at user end) are characterized by limited computational capability (consistent with low power constraint), and size. Second, the knowledge of the propagation environment at any one device will be limited to local channel conditions only (i.e. the channel conditions directly observable from measurements at that device) in order to limit the inter-node signaling. Exchange of channel-related knowledge between nodes directly competes with the resource allocated to the payload data transfer itself. This prohibits the form of centralized optimization which is typically assumed when applying traditional spatial processing (precoding, decoding).

To deal with these challenges, distributed MIMO-type techniques must be sought, whereby each nodes performs precoding operations based on local knowledge, allowing the network as a whole to extract global MIMO gains. This property can also be regarded as a feature of a self-organizing network at the PHY layer.

Recently, a subset of this problem was addressed in a 2010 paper [3] where a solution based on so-called team decision theory was suggested.

The more general frameworks of decentralized cooperative processing are illustrated in [2].

### **Relays to deal with interference**

In addition to the problem of distributed cooperative transmission, the candidate shall investigate the use of relays as an alternative (or complementary) tool to deal with interference. Traditionally, relays are envisioned as a method for range extension or to give diversity in fading channel environments.

However, recent contributions have hinted at the fact that relays can help suppress interference by acting cooperatively with one or more base stations. The crucial question is therefore whether the use of (fixed) relays can help avoid the need for base station cooperation or whether it has a specific additional role to play in wireless cellular networks.

We shall seek contributions both in the form of fundamental information theoretic or communication theoretic concepts and/or proposal of novel practical transmission schemes.

**Practical conditions:**

The candidate shall work within the Communications Theory Group of EURECOM, located in international Tech Park Sophia-Antipolis, 20 min from the Nice Airport. The working language is English.

The position is partly funded by the participation in the EU project ARTIST4G, which is the leading collaborative scientific in Europe dealing with cooperation in cellular networks.

Competitive salary and benefits packages are offered for the duration of the Postdoc. The duration is no less than 1 year and no more than 1.5 years.

**Contact:**

Please contact Prof. David Gesbert ([gesbert@eurecom.fr](mailto:gesbert@eurecom.fr)) directly to apply. Your application email shall include:

- A short motivation statement describing why you intent to do a Postdoc and your past experience with related topics such as cooperative transmission, MIMO systems, and relays.
- One or two names of professors, supervisors, acting as reference for you.

**References (available upon request):**

[1] A. Ozgur, O. Leveque, D. Tse, "Hierarchical Cooperation Achieves Linear Capacity Scaling in Ad hoc wireless networks", IEEE Trans. on Information Theory 2008.

[2] D. Gesbert, S. Hanly, H. Huang, S. Shamai, O. Simeone, W. Yu, "Multi-cell MIMO cooperative

networks: A new look at interference”, to appear in IEEE Journal on Selected Areas in Communications, 4<sup>th</sup> quarter 2010.

[3] R. Zakhour, D. Gesbert , “Team decision for the cooperative MIMO channel with imperfect CSIT sharing”, Invited Paper, The Information Theory and Applications (ITA) Workshop, San Diego CA., February 2010.