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**Doctoral Research Proposal at NOKIA Bell Labs in Munich
in cooperation with TU Ilmenau, Communications Research Laboratory**

Research Topic: New Radio Mobile Radio Systems – With Machine Learning to Enhanced Spectral Efficiency

5G mobile radio system research and standardization is ongoing and in 3GPP the first so called new radio (NR) Release 15 standard is available. Currently, enhancements for NR Releases 16, 17 or even higher are being investigated with the goal to increase the already good system level performance of Release 15 further. For example, one option is to combine massive MIMO (mMIMO) with joint transmission cooperative multi point (JT CoMP). Related important enablers are efficient channel estimation and reporting of channel state information (CSI) for a high number of relevant channel components. Accordingly, there is an ongoing NR mMIMO working item. Competing proposals for efficient CSI feedback exist, like either implicit codebook based solutions or using explicit time domain reporting that rely on compressed sensing gains.

Explicit time domain CSI opens the door to channel prediction based on an estimation of the multipath component parameters comprising a channel impulse response (CIR). JT CoMP and the mentioned enablers are powerful, but complex and machine learning in combination with deep neural networks (DNN) looks promising. DNNs have become very popular, but the goal of this work would be to carefully evaluate the benefits and limits of DNNs for the intended PHY (physical) layer applications like the already mentioned channel prediction.

Potential areas of work are:

- Integrating machine learning based on DNNs into the overall JT CoMP framework and evaluation of benefits, limitations and drawbacks
- Channel estimation, reporting and prediction for massive MIMO and JT CoMP
- System level analysis of massive MIMO in combination with JT CoMP
- Influencing 3GPP NR standardization to support the identified solutions

Desired expertise and skills: The doctoral candidate should hold an excellent Diploma or Master's degree in electrical and computer engineering or a related area. The candidate should have an expertise in communications and signal processing along with a very good (oral and written) command of the English language. Knowledge of machine learning tools is a plus. Applications that include a covering letter, a photograph, a detailed CV, grade reports, a copy of the Master thesis, and other usual documents should be sent by e-mail to Martin.Haardt@tu-ilmenau.de

Expected starting date: As soon as possible. Applications will be considered until the position is filled.

Duration: 36 months

Who is Nokia Bell Labs: Bell Labs defines Nokia's technological and architectural vision for the ICT industry, identifies the key challenges in this vision and invents solutions that are an order of magnitude (10X) better than existing solutions. In Munich we aim at delivering research, technology and system concepts in the areas of: radio access architectures, radio network algorithms, and radio interfaces technologies. Our studies focus on enhanced/new technical solutions for existing and new air interfaces and radio access networks and protocols. Our leading radio research provides Nokia with competitive system concepts, patents (IPRs), technology and methodology to secure long term competitive product provisioning in collaboration with external partners, customers, universities and research institutes. Nokia Bell Labs is a multinational team being located at different sites like Aalborg, Arlington Heights, Espoo, Munich, Oulu, Paris and Stuttgart.