Orchestration and Reconfiguration Control Architecture

Open Call 1

First ORCA Competitive Call for Extensions

Real-Time Digital Self-Interference Canceller for In-band Full-Duplex Enabling up to 100 dB of Total Isolation

Call - Identifier	ORCA-OC1-EXT4
Organisation name:	Tampere University of Technology (TUT)

Section A Project Summary

This proposal aims to develop and provide a real-time implementation of a nonlinear digital self-interference canceller (SIC), which will enable real-time demonstration of in-band full-duplex (IBFD) communications on the ORCA platform. The current ORCA IBFD demonstrator includes an electrical balance duplexer (EBD) to provide about 50 dB of RF isolation/cancellation for the transmit signal entering the receiver, but lacks real-time digital SIC capability, which is essential to make IBFD feasible. We target to provide an additional 45-50 dB of digital cancellation, which would bring the total transmitter-to-receiver isolation to 100 dB. This is a very challenging objective, especially considering that such real-time digital cancellation numbers have never been reported in the open literature.

The project will draw from our extensive previous work on nonlinear SIC algorithm development and IBFD experiments. We have also produced two real- time demonstrations of a nonlinear digital SIC with state-of-the-art performance. These studies form an exceptionally good and solid foundation for this proposal, and we believe that we are in the best possible position to take on this challenge.

The developed real-time digital SIC solution will take into account the impairments inherent to typical software-defined radio (SDR) devices, which are known to limit digital SIC performance. These may include the nonlinearities of the power amplifier (PA), the in-phase/quadrature (I/Q) mismatches, as well as low-noise amplifier (LNA) and baseband nonlinearities. The design will be delivered as both C++ and VHDL code to facilitate flexible application on different implementation platforms.

In addition to meeting the functional requirements stated in the Call, further validation of the developed solutions on the ORCA testbed will be done by establishing a true bi-directional IBFD transmission link, and obtaining relevant measures such as bit-error-rate and packet loss ratio.