Optical Communication with QPSK modulation and polarization multiplex is an attractive approach to increase the capacity of existing 10 Gbit transmission systems. Coherent detection with DFB lasers yields an intradyne signal which is sampled and digitized. Demodulation and decoding is done in a digital signal processing unit (DSPU). The DSPU is programmed in VHDL which enables implementation on both an FPGA and a CMOS chip.

The main problem of the described QPSK receiver is the recovery or estimation of the carrier phase, especially when DFB lasers are employed. The phase estimator of Viterbi and Viterbi was modified and optimized for this application. Furthermore, a novel and very hardware-efficient phase estimator was developed and succesfully employed for the first QPSK realtime transmission experiment with DFB lasers in 2006.

It is possible to double the transmission capacity of a QPSK system by polarization multiplex, but this requires the multiplication of the received signal with a time-variant compensation matrix in the DSPU. To calculate this matrix with 8 or 16 degrees of freedom, a correlation-based polarization control was developed. The polarization control was succesfully combined with the phase estimator and fulfilled highest speed requirements in another experiment.