

# FPGA-based triggered-phase transient analyzer

M. Kazda

Physikalisch-Technische Bundesanstalt (PTB),  
Bundesallee 100, 38116 Braunschweig, Germany

Email: Michael.Kazda@ptb.de

Caesium fountains are susceptible to cycle-synchronous phase transients in the microwave interrogation signal. To evaluate and subsequently reduce this potential source of frequency shifts in our microwave synthesis<sup>1</sup>, a phase transient analyzer with coherent averaging synchronous to the fountain cycle can be used. In 2009 the group at LNE-SYRTE presented such triggered-phase transient analyzer<sup>2</sup>. Based upon this idea we are implementing a phase transient analyzer utilizing a field-programmable gate array (FPGA).

Our setup consists of an off-the-shelf FGPA-system from National Instruments with a 120Ms/s 16 bit analog-digital converter (ADC) front-end. The data acquisition and filtering is entirely carried out within the FPGA, making it possible to use advanced digital signal processing (DSP) technologies and high order filters. As a first step we are implementing the downmixing scheme proposed in [2], subsequently employing a digital I/Q demodulation and phase detection. As a frequency reference we are using a copy of the fountain microwave synthesis, allowing us to modulate the reference frequency synchronous to the microwave interrogation signal.

Due to the higher sampling rate and the advanced filtering and DSP techniques used we expect to reach sub-microradian resolution with a measurement time significantly lower than in reported in [2]. As further steps we plan to implement more advanced phase detection schemes. Subsequently a track-and-hold front-end with an all-digital phase measurement scheme similar to [3] will be implemented.

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<sup>1</sup> M. Kazda, V. Gerginov, N. Nemitz, and S. Weyers, IEEE Transactions on Instrumentation and Measurement (Volume:62, Issue: 10)

<sup>2</sup> G. Santarelli et al., IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control (Volume:56, Issue: 7)

<sup>3</sup> S. Römisch, T. E. Parker, and S. R. Jefferts, Proceedings of the 41st Annual Precise Time and Time Interval Systems and Applications Meeting (pg. 397 – 408)