

# A low-delay reference tracking algorithm for microwave measurement and control

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In FEL (Free-Electron Laser) accelerators, LLRF (Low-Level Radiofrequency) systems usually deploy feedback or feedforward algorithms requiring precise microwave measurement. The slow drift of the clock allocation network of LLRF significantly impacts the measured microwave phase, thereby affecting the stability of the closed-loop operation. The reference tracking algorithm is used to eliminate the measurement drift. The conventional algorithm is to perform phase and amplitude demodulation on the synchronous reference signal from the main oscillator and subtract the reference phase in other measurement channels. The demodulation is usually based on the CORDIC, which requires approximately 16 clock cycles in FPGA (Field Programmable Gate Arrays). This paper uses the multiplication of complex numbers, which only requires four clock cycles of computational delay and achieves phase subtraction point by point. Nevertheless, it causes irrelevant amplitude noise to overlap and may increase the amplitude measurement noise. This reference tracking algorithm is suitable for control algorithms with low-delay requirements of microwave measurement.

## Keyword

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