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Digital Low Level RF Control System for the DESY TTF VUV-FEL Linac

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In the RF system for the Vacuum Ultraviolet Free Electron Laser (VUV-FEL) Linac each klystron supplies RF power to up to 32 cavities. The superconducting cavities are operated in pulsed mode and high accelerating gradients close to the performance limit. The RF control of the cavity fields to the level of $1e-4$ for amplitude and 0.1 degree for phase however presents a significant technical challenge due to the narrow bandwidth of the cavities which results in high sensitivity to perturbations of the resonance frequency by mechanical vibrations (microphonics) and Lorenz force detuning. The VUV-FEL Linac RF control system employs a completely digital feedback system to provide flexibility in the control algorithms, precise calibration of the accelerating field vector-sum, and extensive diagnostics and exception handling capabilities. The RF control algorithm is implemented in DSP firmware and DOOCS (Distributed Object Oriented Control System) servers. The RF control system design objectives are discussed. Hardware and software design of the DSP based RF control are presented.

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