Estimation of Faults in DC Electrical Power System

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This paper demonstrates a novel optimization-based approach to estimating fault states in a DC power system. The model includes faults changing the circuit topology along with sensor faults. Our approach can be considered as a relaxation of the mixed estimation problem. We develop a linear model of the circuit and pose a convex problem for estimating the faults and other hidden states. A sparse fault vector solution is computed by using ℓ_1 regularization. The solution is computed reliably and efficiently, and gives accurate diagnostics on the faults. We demonstrate a real-time implementation of the approach for an instrumented electrical power system testbed at NASA. Accurate estimates of multiple faults are computed in milliseconds on a PC. The approach performs well despite unmodeled transients and other modeling uncertainties present in the system.