

Asynchronous Decomposition Method for the Coordinated Operation of Virtual Power Plants

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Virtual Power Plant (VPP) aggregates and coordinates community-owned renewable distributed generations (DGs) and flexibility resources for participating in power system operation. In this paper, the coordinated operation problem of VPPs and the distribution system operator (DSO) is formulated as minimizing the total operational cost constrained by linearized three-phase power flow equations and operational constraints. To preserve the VPPs' privacy, the DSO needs to coordinate the VPPs in a distributed manner. However, conventional synchronous distributed methods may suffer from communication delays or failures because of the flimsy communication conditions between DSO and VPPs. We propose an asynchronous distributed algorithm that is robust against communication uncertainties. Firstly, a hybrid alternative direction method of multipliers (ADMM) algorithm is developed, which can be applied to convex problems with promising convergence performance. In the hybrid ADMM framework, the delayed or missing data that transmitted from VPPs are compensated by a novel predicting algorithm combining the multi-parameter quadratic programming (MPQP) and autoregressive integrated moving average model (ARIMA). We prove that the proposed algorithm can converge under imperfect communication condition with some mild assumptions. Numerical tests on IEEE 33-bus and IEEE 123-bus systems indicate that the proposed method has more reliable and faster convergence performance than existing asynchronous methods in all cases.