Distributed Control in a Network of Households with μCHP.

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Abstract

This is an application of a dynamic price mechanism to distributed optimization of a network of houses which are both producers and consumers of electricity. One interesting candidate for domestic power generation is the Micro Combined Heat Power system (μCHP). In this device gas and power come together, and we are in particular interested in the electric output. We use a pricing mechanism based on dual decomposition, that was combined with feedback controllers in [1], and apply it to the modeling of the electrical power grid. In the end we perform a numerical test with realistic electricity demand patterns obtained from real data. Figure 1 shows promising numerical results; The demand in a cluster of 5 households is satisfactory followed by the unconstrained production.

The network of households is described by the dynamic equation $x(t+1) = Ax(t)+Bu(t)+d(t)$, where communication between neighbors is defined by system matrix A, $x(t)$ is the electricity balance information, $u(t)$ is the controlled change in electricity production and $d(t)$ is the change in electricity demand. A quadratic cost function is used to describe the performance.

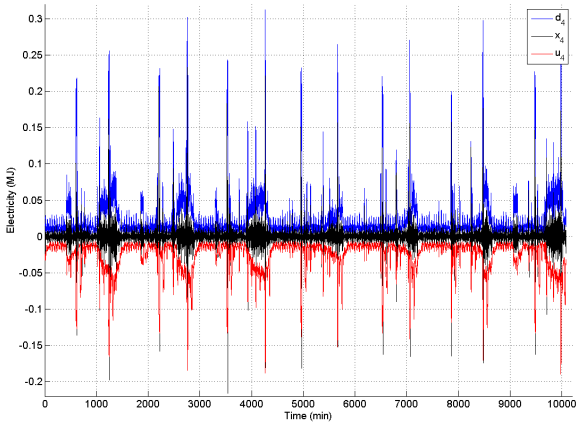

Figure 1: Simulation of five households connected in a chain. This means that price information is communicated to two direct neighbors. The blue line, d, is the realistic demand pattern obtained from field tests (TNO), the red line, u, is the controlled electricity production, and the black line, x, is the balance information that should go to zero.

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References

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