World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:13, No:04, 2019

Deep Reinforcement Learning Approach for Optimal Control of Industrial Smart Grids

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Abstract : This paper presents a novel approach for real-time and near-optimal control of industrial smart grids by deep reinforcement learning (DRL). To achieve highly energy-efficient factory systems, the energetic linkage of machines, technical building equipment and the building itself is desirable. However, the increased complexity of the interacting sub-systems, multiple time-variant target values and stochastic influences by the production environment, weather and energy markets make it difficult to efficiently control the energy production, storage and consumption in the hybrid industrial smart grids. The studied deep reinforcement learning approach allows to explore the solution space for proper control policies which minimize a cost function. The deep neural network of the DRL agent is based on a multilayer perceptron (MLP), Long Short-Term Memory (LSTM) and convolutional layers. The agent is trained within multiple Modelica-based factory simulation environments by the Advantage Actor Critic algorithm (A2C). The DRL controller is evaluated by means of the simulation and then compared to a conventional, rule-based approach. Finally, the results indicate that the DRL approach is able to improve the control performance and significantly reduce energy respectively operating costs of industrial smart grids.

Keywords : industrial smart grids, energy efficiency, deep reinforcement learning, optimal control
Conference Title : ICAE 2019 : International Conference on Applied Energy
Conference Location : Tokyo, Japan
Conference Dates : April 22-23, 2019