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SCHEDULING OF DIRECT LOAD CONTROL USING GENETIC PROGRAMMING

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Abstract. *A modified Genetic Programming (GP) called block deepening GP (BDGP) is proposed in this paper to optimize the scheduling of direct load control (DLC). A search scheme similar to the breadth first search approach in artificial intelligence is adopted in the BDGP to search for the optimal scheduling arrangements. BDGP is composed of a master GP and a slave GP. As the master GP evaluates the status combination of all load groups at every time step, it calls upon the slave GP to simultaneously look ahead an additional D steps to evaluate the best possible load difference that could result. The best status combinations in the following D steps associated with the status combination under evaluation are determined globally in the following D-step block. Since the proposed BDGP optimizes the scheduling for DLC aiming to minimize the load difference in the next time step and the following D time steps, the scheduling results obtained by BDGP are closer to the globally optimal solution.*
Keywords: Genetic programming, Direct load control, Optimization, Scheduling

1. **Introduction.** Direct control of air conditioning load is an effective load management scheme for clipping summer peak load. Direct load control (DLC) is a deliberate utility intervention into customers' air conditioner operations [1,2]. During the control period, the utility sends out signals from time to time through appropriate communication media disabling some customers' air conditioners for a period of time. As the disabling interval ends, the air conditioners under control regain self control and operate based on their original thermostat settings. Utilities have different objectives for load control. Clipping peak load and/or reducing production cost are the most common objectives [3]. Applying DLC to reduce the peak load is usually used to increase system reserve margins and improve system security. For utilities buying or generating power from different resources, reducing load from the demand side through DLC at the appropriate time for an appropriate duration may result in significant production cost savings. There are usually a large number of customers participating in the direct load control (DLC) program. For the convenience of control, the customers are divided into several load groups [4]. Each load group has different load shedding capacity. To avoid affecting customer cooling comfort, the maximum allowable time turning air conditioners off and the minimum time the air conditioners remain running are both constrained for each load group. A target load shedding curve is set up according to the load forecast and the load to shed at each sampling time. To meet the target load shedding curve, a scheduling approach is designed to select appropriate load groups at appropriate times for load shedding in accordance with the time constraints of every load group.

Various optimization approaches have been proposed to solve the scheduling of DLC. Dynamic programming is one of the commonly used optimization schemes. In [5], dynamic