A Congestion Management Allocation Mechanism for Multiple Transaction Networks

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Abstract: We present a physical-flow-based congestion management allocation mechanism for multiple transaction networks. We use the multiple transaction network framework constructed in [1] to characterize transmission congestion and then determine the contribution to congestion attributable to each transaction on a physical-flow basis. This allocation scheme explicitly addresses the issue of counter flows. The allocation results are used in the independent grid operator's (IGO) congestion relief so as to allow it to acquire relief services to remove the overload congestion attributed to each transaction from the network in the most economic manner. The congestion charges attributable to each transaction for its usage of the network are also determined. We tested the proposed scheme on several systems, and we illustrate its capabilities on a network based on the IEEE 57-bus system. We discuss the policy implications of the congestion relief allocation solution. The proposed scheme provides physically reasonable results and is applicable to large-scale networks.

Keywords: Congestion management allocation, multiple transaction networks, open access transmission regimes, transmission pricing, allocation mechanisms.

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Discussion Deadline: July 2002

Gaming the Uniform-Price Spot Market: Quantitative Analysis

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Abstract: A range of indexes have been derived to quantify the incentives to game the uniform-price spot market. The gain of a portfolio generator due to withdrawing capacity and/or inflating the price bid has been found to be proportional to the in-merit market share of the gaming generator and the inverse combined price elasticity of supply/demand. A gaming index has also been derived as a modification of the Herfindahl-Hirschman Index, which takes into account the reduction in the number of competitors as the demand goes up and the benefit the portfolio generators take from gaming. Price-elastic loads reduce gaming opportunities but do not remove them. Application of the indices has been illustrated using the spot market in England and Wales. The results seem to confirm practical evidence from many countries that spot markets are vulnerable to gaming.

Keywords: Power system economics, deregulation, energy auction.

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Discussion Deadline: July 2002

Synchronization of Asynchronous Wind Turbines

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Abstract: A theoretical analysis and explanation of synchronization phenomena in wind parks with asynchronous generators is presented.

Keywords: Asynchronous wind turbine, slow voltage fluctuation, synchronisation of induction machines, wind energy, wind park.

Preprint Order Number: PE-723PRS (02-2002)

Discussion Deadline: July 2002

Parallel Micro Genetic Algorithm for Constrained Economic Dispatch

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Abstract: This paper proposes a parallel micro genetic algorithm (PMGA) for solving ramp rate constrained economic dispatch (ED) problems for generating units with nonmonotonically and monotonically increasing incremental cost (IC) functions. The developed PMGA algorithm is implemented on the 32-processor Beowulf cluster with Ethernet switches network on the systems with the number of generating units ranging from 10 to 80 over the entire dispatch periods. The PMGA algorithm carefully schedules its processors, computational loads, and synchronization overhead for the best performance. The speedup upper bounds and the synchronization overheads on the Beowulf cluster are shown on different system sizes and different migration frequencies. The proposed PMGA is shown to be viable to the online implementation of the constrained ED due to substantial generator fuel cost savings and high speedup upper bounds.

Keywords: Parallel micro genetic algorithm, economic dispatch, Beowulf cluster.

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Equilibrium of Auction Markets with Unit Commitment: The Need for Augmented Pricing

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Abstract: We discuss issues and methods for attaining equilibrium in electric power auction markets with unit commitment. We consider a generation-side competition whereby producers are profit maximizing agents subject to prices only. For expository purposes, we will consider the single-period unit commitment problem, which is still quite rich for this presentation. We show that it is possible to eliminate the duality gap or cycling that occurs in a decentralized decision-making environment that encompasses discontinuous nonconvex programs. This result extends previous work on coordination of locally constrained self-interested agents, and it has a broad scope of applications that may be of interest to power systems engineers, market designers, economists, and mathematicians.

Keywords: Quality, integer programming, mathematical programming, operations research, optimization methods, power generation dispatch, power generation economics, power generation scheduling, power system economics, quadratic programming.

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Network-Constrained Economic Dispatch Using Real-Coded Genetic Algorithm

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Abstract: A genetic algorithm (GA) solution to the network-constrained economic dispatch problem is presented. A real-coded GA has been implemented to minimize the dispatch cost while satisfying generating unit and branch power flow limits. A binary-coded GA was also developed to provide a means of comparison. GA solutions do not impose any convexity restrictions on the dispatch problem. The proposed method was applied on the electrical grid of Crete Island with satisfactory results. Various tests with both convex and nonconvex unit cost functions demonstrate that the proposed GA locates the optimum solution, while it is more efficient than the binary-coded GA.

Keywords: Genetic algorithm, economic dispatch.

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