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SCHEDULING OF HYDROPOWER SYSTEM IN APPROACH OF METAHEURISTIC

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ABSTRACT:

The individuality of the manufacturing units and the diagram of their efficiency curves are taken into account. The mathematical model is designed as a dynamic, mixed integer, nonlinear, nonconvex, combinatorial and multiobjective optimization problem. We suggest two solution methods using the metaheuristic approach. They combine genetic algorithms with Strength Pareto Evolutionary Algorithms and Ant Colony Optimization. Both approaches are divided into two phases. In the first, the problem is solved for each hour of the day (static transmission), to create a net of the plant. In the second stage, to reduce the switching on-off of the units, the whole day is considered.

KEYWORDS : nonconvex, combinatorial and multiobjective optimization problem.

INTRODUCTION:

The planning / scheduling of operation of this system is divided into three phases: long term, medium term and short term. The horizon is up to five years with a monthly time-step over the long term. In this stage, plants are grouped by sub-systems. The horizon is up to a year with a monthly or weekly time-step in the medium term. In this stage, the plants are treated individually. In the short term the horizon is up to two weeks with hourly time-steps. In this phase the production units (GUs) of the plants are considered and physical, electrical and hydraulic aspects are taken into account. Optimal Dynamic Dispatch (ODD) of GU has been created within the short-term stage, which is the focus of this paper. This includes determining for each hour of the day which units should operate and their production levels. It aims to meet the energy demand, make optimum use of available water resources and reduce the maintenance cost of GU.

Two equations are important for the ODD of GUs: hydraulic balance and production function, according to Hidalgo et al. The hydraulic balance determines the final volume of the reservoir from the initial volume, water inflow and water outflow. The production function relates the plant's generation to turbine efficiency, generator efficiency, purge head and water discharge. Optimum utilization of available water resources is related to efficient operation of the plant. The maintenance cost of the GU is affected, among other things, by the number of startups and shutdowns during operation. Each switching on-off of a unit is estimated to reduce its useful life by approximately 10 to 15 hours.

The ODD problem has two main objectives: to increase the net generation of the plant and to reduce the number of changes in the position of the GU. System constraints related to this problem include meeting load demands and respecting physical, electrical and hydraulic constraints. It has discrete variables for the selection of the GU and continuous variables for the loading dispatch of each online GU. The production function of a hydroelectric plant and the efficiency curves of the units are nonlinear. ODD problems are usually non-convex. The combined nature of the problem makes it more complicated.

ODD number problem sodvanyasathi artificial intelligence system implemented banana geleahe. The Santos and Ohishi three Brazilian hydroelectric systems implement genetic algorithms (GA) and Lagrangian relaxation (LR). Unit Commitment (UC) problem Muller GA and Sequential Quadratic Programming (SQP) back to Jenkaroon Weiss NirmandytilTotaKamHoil. Colnago problem sodvanyasathi GA's vaparto.Naresh and Sharma HydrosystemSchedulingSathi Artificial Neural Network (ANN) var based model Regards. HuangneHydroelectric Generation Scheduling Vadhavanyasathi Ant Colony System (ACS) Ver Based Optimization Approach Proposed Banana. Luxury et.al. Hydroelectric Generating Units Pathavanyasathi Multi-Objective Evolutionary Algorithm (MoEA) has been appointed. Musirin etc. Objective Tasks Mission Expenditure Reduction Strategy with Economic Visa Text Text Problem Solving Implement Ant Colony Optimization (ACO) mechanism. Columbus etc. Propose Nodal Ant Colony Optimization (NACO) Mechanism for UC Problem Sodvanyasathi Objective Task Method. Mo et al. Short Term Hydrogenation Scheduling Problem Sodavanyasathi Multi-Ent Colony System (MACS) and Adaptive Differential Evolution (ADE) var based hybrid algorithm Regards.

MATHEMATICAL FORMULATION:

1. Functions according to Objective

The proposed optimization model has two conflicting objectives: (1) to increase the total net production of the plant and (2) to reduce how often the state of the GU has changed. The Jupina and Porto Primavera are individually optimized, as they are operated as run-of-the-river plants:

$$\max \sum_{t=1}^{24} \sum_{u=1}^{U} g_u^t \eta_u^t \left(h_p, g_u^t\right)$$

Equation – 1

$$\max \sum_{t=1}^{24} |y_u^{t+1} - y_u^t|$$

Where,
t = index time period,
u = GU index
U = GU Total Number
Gus; g_u^t = generation of the unit u, in the time period t (MW)
η_u^t = efficiency of the unit u, in the timeperiod t
h_p = net head of the plant
y_u^t = A binary variable that indicates whether the unit is active during the period (1 = active, 0 = inactive)

2. Constraints:

Optimization for each period is subject to the following restrictions. Inequality (2) is the limit of demand by the busbar, which states that the electricity generated must meet the specified load demand. According to (3), the sum of the water discharges of the units is equal to the total water discharge of the plant. Since the trees are walking on the river, the inflow of water must be equal to the outflow of water, discharge of water and leakage of water (4). Inequality (5) and (6) specify the lower and upper boundaries of net formation, respectively:

$$\sum_{n=1}^{U} g_u^t \, \eta_u^t(h_p, g_u^t) \geq Dem^t$$

Equation – 2

$$\sum_{n=1}^{U} d_u^t$$

Equation – 3

$$I^t = D^t + S^t$$

Equation – 4

$$g_u^t \eta_u^t(h_p, g_u^t) \leq (min) g_u^t \eta_u^t(h_p, g_u^t)$$

Equation – 5

$$g_u^t \eta_u^t(h_p, g_u^t) \leq (max) g_u^t \eta_u^t(h_p, g_u^t)$$

Equation – 6

Where,

Dem^t = Plant Demand on the t time
(MW);d^t = water discharge of the unit u, in the time period$t$ (m^3/s);
D^t = water discharge of plant in time period t(m^3/s);
I_p^t = water inflow of the plant, in the time period t (m^3/s) and
S^t = water spillage of the plant, in the time period$t$ (m^3/s)

3. Variables:

The integer and continuous variables of the model are shown in the integrity limits (7) and (8), respectively. Integer variables are used for selection of GUs and continuous variables are used for loading dispatch of selected GUs:

$$y_u^t \epsilon \{0,1\}$$

Equation – 7

$$g_u^t \in R$$

Equation – 8

Both approaches are divided into two phases. In the first stage, the problem is solved for each hour of the day (static transmission), to create a net of plants using GA. The resulting population consists of a set of individuals with transmission solutions for each hour of the day. These measures are randomly combined to prepare individuals for the second phase of the initial population. For the first approach, phase 2 uses SPEA. In our issue, this multipurpose algorithm seeks to increase the net generation of the plant and reduce the switching of GUs between on-off. This day is considered full (dynamic transmission). The resulting algorithm saves the solution of non-dominance in external storage. For the second approach, ACO is used in phase 2. Ants use search space based on the experience they have accumulated. In this approach, dynamic remittance is solved as a problem of minimum cost route. The main objective of this phase is to reduce the switching on-off of GUs using state transition rules. The first objective function is also considered because the search space contains the best solution of the first phase. The trade-off curve is used to handle both objective functions simultaneously.

CONCLUSION AND SUMMARY:

Satisfaction strategies using GA, SPEA and ACO have two stages. The first solves the constant problem for every hour of the day, so that the total net formation of the plant. The second stage is related to connection. Static solutions throughout the day by setting dynamic transmission,its objectives are to reduce the total net production of the plant and the number of startups and close units. The proposed approach applies to two hydroelectric plants operating in the cascade: the Jupina and Porto Primavera plants. Two day eight case studies of these two plants are conducted by comparing GA + SPEA and GA + ACO strategies. For the case studies of this research, overall, the GA + SPEA approach shows good results for the work of both objectives of the problem. This can be seen in frames I, II and IV where the GA + SPEA column has higher net product values and lower startup and shutdown. In addition, in general, GA + SPEA presents good results in terms of net formation of plants and shows excellent performance in relation to switching on-off of GU as shown in GA + ACO Frame III. This may occur because, in Phase 2, SPEA is simultaneously related to both objectives of the problem, as it is a multipurpose algorithm, while ACO focuses on the second objective, reducing the on-off of the GU, although the first objective is also considered in a predetermined way.

Finally, both solution strategies, GA + SPEA and GA + ACO, are good options for solving optimal dynamic transmissions in the short-term operation of hydropower plants. As a future work, the authors have repeatedly proposed to run models to collect expressive numbers of case studies. Large scale statistical analyzes will be applied to compare the media more accurately.

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