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Weight Feedback Adaptive Multi Objective Cooperative Scheduling in Smart Grid Application

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***Abstract*: Smart grid integration needs a highly accurate power scheduling to minimizes the losses and efficiently utilize the power supply to minimize the loss. Scheduling of a smart grid interface is monitored based on single or multiple objectives scheduler, where the smart grids are scheduled based on the measured parameters of power dispatch and the consumption model. Wherein, multi objective scheduling results in prominent result, the system is a linear monitoring model, where no previous observations are considered in making present decision. This constraint the accuracy of scheduling. In this paper, a new feedback scheduling operation based on feedback operation is proposed. the approach significantly feedbacks the past parameter variation and leads to an optimal power supply in smart grid interface. The experimental results obtained signifies a optimal improvement in the decision delay and power compensation.**

***Index Terms*: feedback control, weight feedback optimization, smart grid interface, multi objective scheduling.**

I. INTRODUCTION

With the increase in demanded power supply, the conventional modeling of power supply are getting highly constraint in meeting the demand of upcoming consumption. The compensation of such demand is developing through new smart grid (SG) integration, where multiple generation, distribution and storage units are integrated to compensate the demand Smart grid (SG) is designed for dynamically connecting / disconnecting the grid should be in grid-connected or regional mode [1, 2]. In a smart grid, the load dispatch plays a significant role in reducing overall operating costs under practical controls[3, 4]. One of the most typical challenges in SG operation, for the operation, is to fulfill the demand distribution load balance for generation and load [5]. In [6], an energy consumption schedules of various SGs linked to an uncertain load demand is proposed. In network-connected mode, distribution network operators (DNO), Network Smart Grids (NSG) Operation, coordinate with the side of the loads is outlined in [7]. SG Optimal Scheduling Problem has been analyzed by Multiple approaches in recent past. The available SGMs are interconnected and communicate with the operation of DNO. In [8] Optimization problem is solved by using max-min- cost, depending on the cost aspects of smart grid distribution. In order to achieve optimal solutions, a rapid algorithm based on dual monitoring plans in mixed integrator linear programming (MILP) format working with demand response program is proposed. In [9] a Hybrid method aimed to develop a low complex programming, optimizing the operating costs of the smart grid system. Today, the plug-in hybrid electric vehicles (PHEVs) and storage devices are the main components for smart grids, the most reliable and the smallest energy sectors. On reference to this, [10] Investigate a robust symbolic algorithm for analyzing the commitment of the SG operation considering different charging methods of SG in the uncertainty of the learning network. One of the significant achievements of smart grids is to improve the network's usage by simplifying the interruptions observed during the natural disaster. [11] present a optimized scheduling of a resilience oriented smart grid on a centralized management system. Scheduling Dynamic Programming Algorithm Based on a Distributed Programming Scheduling based on the optimal usage of smart grids, is presented. [12] Investigate the usage of batteries using standard diagrams, which are used as a source in fuel cells. In other perspectives, the SG Users play a critical role in providing important and reliable functionality for future smart distribution grids. In [13] SG owners and consumers benefit from reliable and financial power supply. In [14] Decentralized markovian approach has been introduced in order to reduce the cost of SGs in a better control framework. Participation companies consider multi-agent monitoring for energy management. A practical architecture of self-regulating SGs for natural computing and self-tuning is presented in [15]. Due to the lack of emergence in SG, this framework uses a optimal computing. More than one SG, through multiple agent systems is used to solve the exchange of cost of generation. The monitor focus on the three-stage architecture based on the deployment of the network. The concept of load sharing was done by resolving the load discharge issue in[16]. In the main usage of the smart grid, financial analysis of SGs has given special consideration to researchers [17]. Smart grids offer a better solution to improve the reliability of the distribution network during quick power requirement.

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On the other hand, energy generators redesigning the power generation with adverse productivity and smart grids, has a monitoring panel, which increase the complexity of evaluation [18]. developing multi-SGs to improve reliability of smart distribution network policies and load demands are handled by smart grids in various areas of application [19]. The significance of smart grid has given many advantages in power system stability, however, the complexity in the evolving network model and variant load demand constraint the operation of such network. in this paper, a multi objective scheduling operation for smart grid interface is proposed. The discrete smart grid scheduling is improved by the load operation to observe the load scheduling. The rest of the paper is outlined in 6 section, where section 2 outline the conventional model of multi objective cooperative scheduling. Section 3 outline the weight feedback adaptive multi objective scheduling approach. The simulation result for the developed approach is outlined in section 4. Section 5 presents the conclusion.

II. MULTI OBJECTIVE COOPERATIVE SCHEDULING [1]

Multi-Objection Co-Operative Schedule (MOCSF) is to minimize power costing, at peak loads and under constraint environment. SG facilities are processed to understand a cooperative environment, where MOCSF is a developed for a set of couples, or as a set of consume and generate associations, when each user demands load together and works on the start time, end time, power utilization a preference mode of application is applied. The main reason behind this depends on the fact that for schedule regularly to keep the exchange between user and producer an objective activity that takes into consideration environmental, economic, and functional factors are considered. An SG consist of the components of power generation (g), demand (d) and storage (s). After applying a cluster algorithm that aims to the SG components which are related to each other to work together, minimizing the objective function that is based on environmental, economic and operational costs. A schedule S for a period T, for the power transfer to the power supply, with electric power (kW), where the Scheduler schedules for the generation and consumption based on the requirement and the time to schedule associations as a result of reducing performance results, economic and environmental aspects. The target function takes into consideration: 1) Calculating the cost of energy at one point, depending on the difference between the required schedule, actual operation, delays, and peak load demand 2) - Calculates the emission in SG to handle the environmental effects. In developing a solution, particle swarm optimization (PSO), to search for optimal scheduling near each association, its direct implementation and the power of optimization is needed. PSO is a computational method for optimizing a problem to improve a solution in an amount of quality supplied by an objective function. It is considered to be a powerful tool for solving complex non-linear optimization problems. The convergence of the decision is defined as the minimization of the cost function

$$\min(\sum_{h=1}^{H} C^t(\sum\sum x^h) \qquad (1)$$

Where the cost function is defined by, the cost function of the developed system is defined by,

$$c^t = \frac{\sum_{u\in U} r_u^t}{k} \qquad (2)$$

where the allocated power r_u^t is defined by

$$r_u^t = \sum_{a\in A} x_{ua}^t * r_{ua}^t \qquad (3)$$

where A the set is defined by A and $a \in A$ is the offered load. After grouping the associates of similar objective, new associative parameter is defined. The objective of regrouping is to obtain the maximum power utilization under the smart grid interface. However, the nature of the unit and the load associated is not been considered. this limits the scheduling convergence and result in lower accuracy.

III. WEIGHT FEEDBACK ADAPTIVE MULTI OBJECTIVE SCHEDULING

For optimal power utilization, in [1] Scheduling approach based on multi objective parameter and cost optimization is suggested. Multi parameter cost function is suggested as a parameter of Satisfaction power for validated consumer and power is switched between the consumer for load delivery. Cost function is defined as a function of demand, time, availability of the power supply and its switching performance. However, there is No observation of type of load demanded and the characteristic variation is not been considered. the past method is developed with the observation of demand, time and supply but type of power demand it is not observed. To monitor the demand variation a type parameter as an additional feedback parameter is proposed. Here we present 3 type of parameters, namely the regular type (R), discrete type (D), hard type(H).

a) Regular – daily at the period but load is varying within a range (8-12 AM) (6-9pm).
b) Discrete – any one moment the load goes high suddenly spike type (printer, motor).
c) Hard type – fixed compulsory needed supply for application such as the lift, locomotives, advertisement etc.

These characteristics of load demand affect the conventional five objectives. We give weight feedback to each of the characteristic and use fuzzy rules to switch the supply. In [1] PSO based optimization is used. However, the diversity of the demanded load could result in slower convergence hence in this work, PSO-with fuzzy logic is used for decision making. Here we propose, 3 power demand characteristics to define how the demand load is varying over a course of time. We define a new cost function to optimize the scheduling. We define a hybrid decision model of PSO-Fuzzy logic for the decision. This work reduces the scheduling overhead by a pre-computation of demanded load. It will reduce the power backup overhead. It increases the power consumption efficiency by finer level scheduling.

The minimum amount of power (MSR) optimization provides the optimal power scheduling by improving the scheduling power defined by the problem. However, MSR consumer has a limit to scheduling global user resources, which is a disadvantage on power schedules.

To optimize power scheduling, a feedback factor γ_{fb}^t is used defined as,

$$\gamma_{fb}^t = \frac{\gamma^t - \gamma_{min}^t}{\gamma_{max}^t - \gamma_{min}^t} \quad (4)$$

Where γ_{max}^t is Maximum power efficiency achievable. weight feedback function, γ_{min}^t is the Minimum energy response function When the network γ_{max}^t is capable of delivering a value of weight feedback value, the value achieved is the power efficiency $\gamma\gamma_{min}^t$ for value of 0. The power function in the restricted power control system governed by θ_{fb}^t to allow a fair platform. This differential feedback function is given as,

$$\theta_{fb}^t = 1 - \frac{|cU^t|}{|U|} \quad (5)$$

The weight feedback function is defined as a function of user constraints with the total value is 1, when the user count (CUs) is 0. For long term fairness the weight feedback function is defined as

$$\phi_{fb} = \frac{(\sum_{u \in U} \sum_t r_u^t)^2}{|U| * \sum_{u \in U}(\sum_t r_u^t)^2} \quad (6)$$

Here, the Long-term scheduling is determined by aggregated observations of long-term energy scheduling. Here, the optimization function is developed by scheduling the power supply to a customer using a discounted load schedule. To monitor the performance of the proposed approach, a simulation result for the advanced approach is as follows. MF varies based on resolution and increases exponentially with increase in rules. Fuzzification refers to the process of converting crisp values into fuzzy linguistic variables or also referred as membership functions. Membership functions LOW, NORM, HIGH are graded with crisp values for each sensor respectively. The input variables can be graded using trapezoidal or triangular membership functions with crisp values varying between 0 and 1. A triangular membership function is used for the implementation of the fuzzy system.

$$\mu_A(x) = \begin{cases} 0, & x \leq a \\ \frac{x-a}{m-a}, & a < x \leq m \\ \frac{b-x}{b-m}, & m < x < b \\ 0, & x \geq b \end{cases}$$

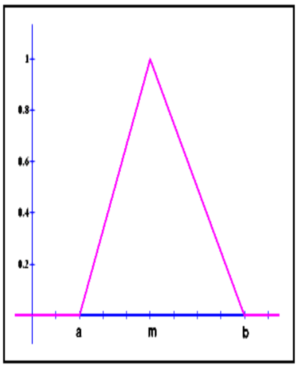

Figure 1. Triangular membership function

The fuzzifier uses membership functions (MF) to describe the variability in the vital parameter. Fuzzy system process the transforming fuzzy set into crisp values. In practice centroid method is employed for defuzzification. Thus FIS can be exclusively devised to implement MOCSF in SG based on load monitoring system with enhanced reliability, accuracy and timeliness. Defuzzification is the final phase of fuzzy system, which transforms fuzzy inferred results into crisp values. In or proposed DFA algorithm, defuzzification role is to transform final inference results into the probability of health conditions of the patient. The output crisp values critical, very critical, normal, very normal are the four probable conditions of the patient. Centroid method of defuzzification can be well utilized in obtaining output crisp values. In the defuzzification process the mean of Maximum (MoM) technique is used. The MoM result an output from the distributed outputs and result into a crisp value based on the mean of all maximums.

IV. SIMULATION RESULT

The proposed scheduling approach operates on the aspects of scheduling using the main features of the total electricity prices, total environmental effect, the offered peak load, and processing weight. The efficiency of the power required by the generated power, the scheduling load, for similar load demand as an input is evaluated. The decision logic used in developing the schedule approach is measured for the offered quality in terms of phase angle, at different power factor supplied with variation on main voltage. The decision delay made for convergence is observed low and the offered electrical load is comparatively high under the WA-MOCSF method. The observations obtained for the simulation a randomly distributed network is as outlined below

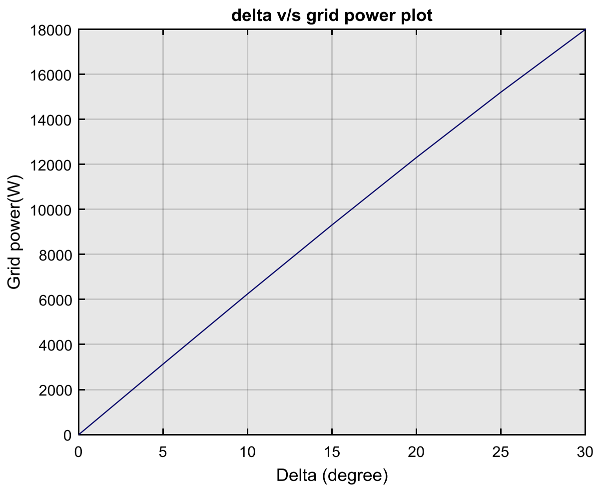

Figure 2. Grid power generation over varying delta factor

The phase delay observation for the grid power for different value of delta value is shown in figure 2. The grid power is observed to be linearly increased with the increase in phase angle. The variation in main voltage has a impact of phase angle.

The variation of phase angle due to change in demanded load for different power Factor is shown in figure

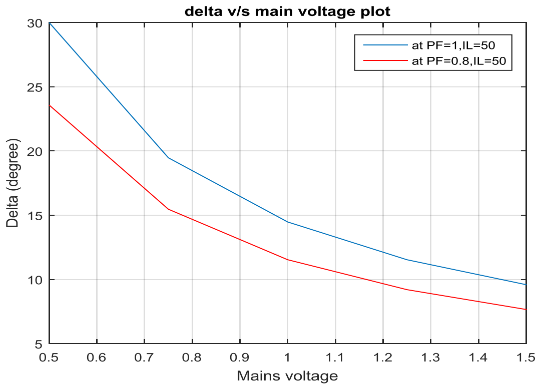

Figure 3. Effect of delta on variation of Main voltage at variant power factor

The variation of the voltage response at grid side and converter side is presented in figure 4. The in phase magnitude at grid side and converter side is seen.

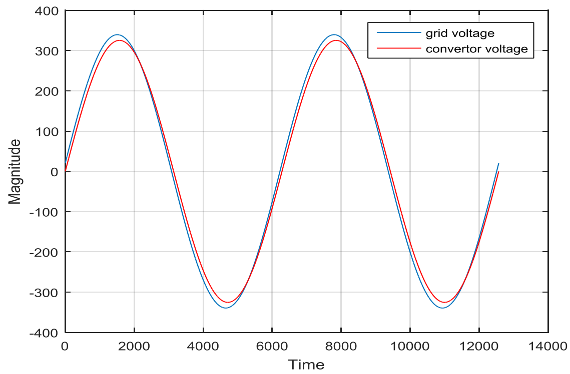

Figure 4. Voltage response at grid and converter unit

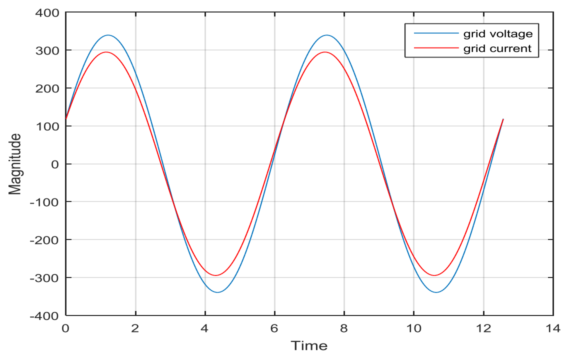

Figure 5. grid voltage and current plot

The observed grid voltage and grid current is shown in figure 5. Figure 6 illustrates the load current and load voltage at the SG in variation with variation of time.

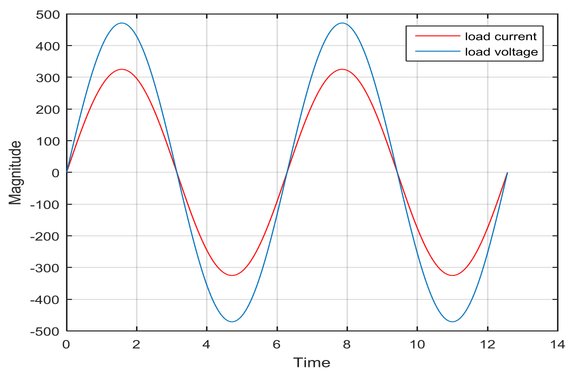

Figure 6. Load current and load voltage for the SG

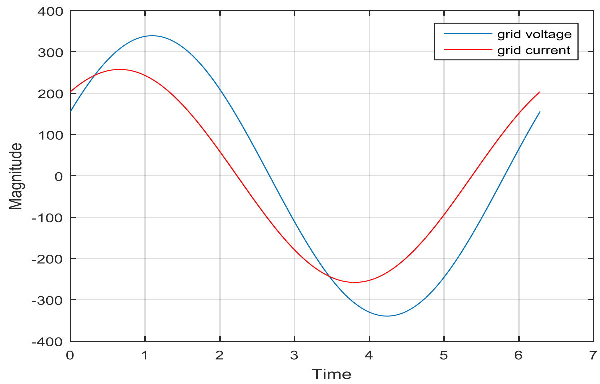

Figure 7. The grid voltage and current plot

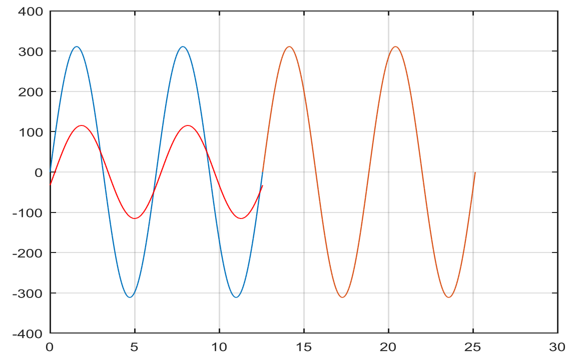

Figure 8. Grid current and convertor voltage for the developed system

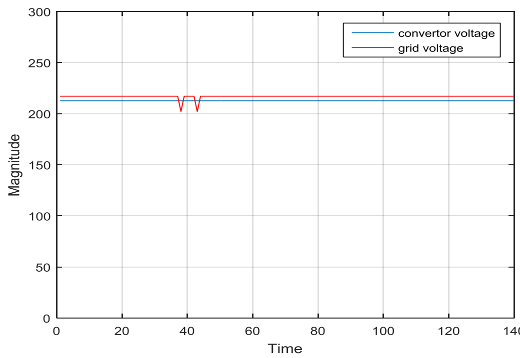

Figure 9. Converter and grid voltage for the developed system

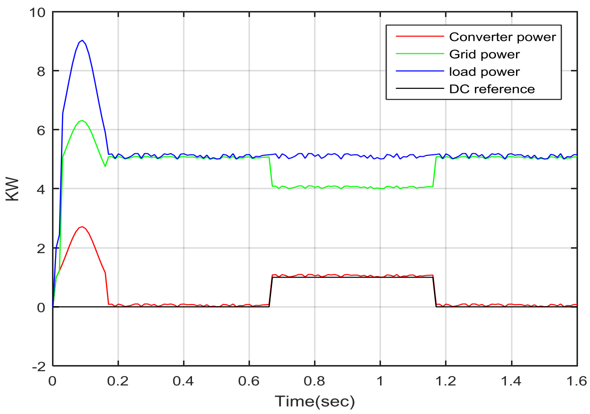

Figure 10. DC reference load power and grid power

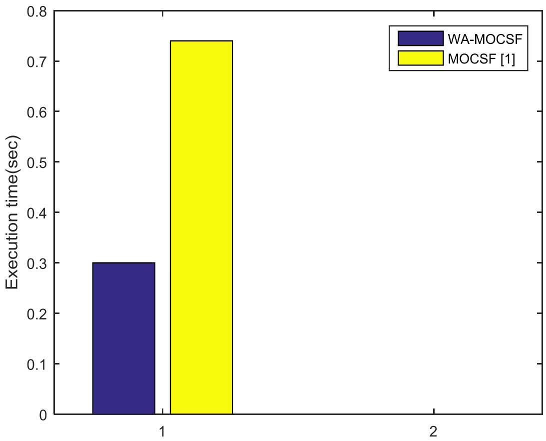

Figure 11. Comparative Execution time for the developed methods

The convergence time delay for the developed system is shown in figure 11. The delay is considerable low by using the adaptive weighted method as compared to the existing approach.

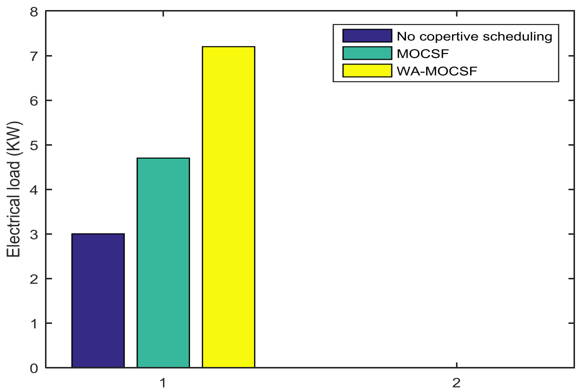

Figure 12. Electrical load (KW) by the scheduling and non-scheduled SG

V. CONCLUSION

A new adaptive scheduling scheme based on the generation / consumption for SG is proposed. A Multi-Objective Cooperative Scheduling for the load scheduling is proposed. The suggested approach gives an advantage of higher power quality and optimal scheduling with minimal delay factor. the objective of the developed system under the monitoring of scheduling based on fuzzy based decision logic is proposed. this approach gives a better stability in power utilization and result in finer scheduling accuracy in smart grid application as compared to the conventional scheduling approach.

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