A REVIEW OF ELECTRICITY MARKET CLEARING PRICE FORECAST BASED ON MACHINE LEARNING TECHNICAL

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Abstract : In this survey discuss on competitive open market environment has been created due to the restructuring in the electricity market. In the new competitive market, mostly a centrally operated pool with a power exchange has been introduced to meet the offers from the competing suppliers with the bids of the customers. In such an open access environment, the formation of bidding strategy is one of the most challenging and important tasks for electricity participants to maximize their print. It is assumed that each participant submits several blocks of real power quantities along with their bidding prices.

***Index Terms* - Day-Ahead Electricity Markets, Electricity Price Forecasting, Time Series Models, Soft Computing Models Neural network, etc.**

I. INTRODUCTION

1.1 BACKGROUND

Competitive electricity power system is based on a deregulated market structure consisting of electricity supplier and consumer transactions, coordination and rules that serve to guarantee competition and non-discriminatory open access. The objective for deregulation is to significantly reduce the cost of power charged to the consumer, simultaneously provide viability for the generating company in realizing income, without compromising on grid reliability and security. This restructured power system objective, which includes competitiveness and customer choice, is facilitated through an energy trading system. Green power is characterized by intermittent generation. For green power trade to be robust, generation and load forecasting, models for market strategy optimization and identification of risks and uncertainties are essential to guarantee grid reliability for consumers, and maximize revenue for generating companies.[11-15]

1.2 FACTORS INFLUENCING PRICE FORECASTING

- In deregulated power markets, fluctuation is a common behavior of price which is because of many different
- economic as well as technical factors. Some researchers have only used historical data of prices or both
- prices and demand to forecast spot price excluding other factors such as weather, fuel cost and generation reserve.
- The various factors that affect the spot price

•Electric Power Demand

One of the important factors in spot price is system's total demand. Studies show that if system demand increases, spot price also increases.[16]

•Whether Conditions

Electricity demand certainly depends on environmental condition and especially daily temperature. Weather fluctuation will affect demand and hence spot price will also be affected. [17]

•Fuel Cost

Fuel cost is one of the main parts of generation cost that its variation has a major impact on electricity spot price [18]

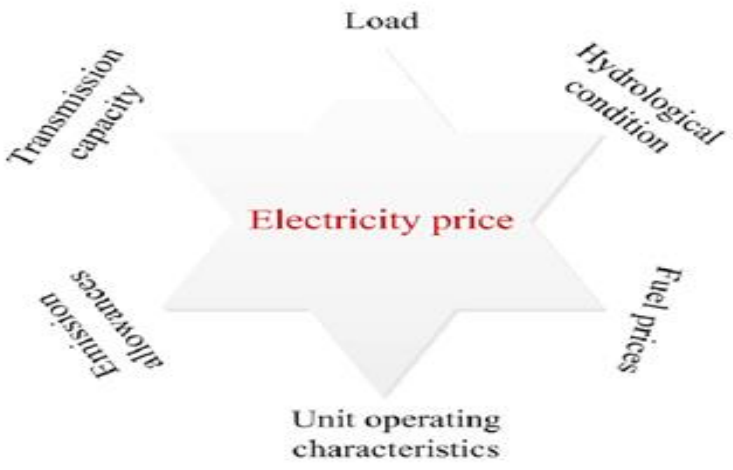

Fig 1.1 Factors affecting electricity prices.

- **Available Transmission Capacity**

Electric power is provided by generator that may be located far from location of consumers. It should be transmitted to consumers via transmission network facilities. There is some physical constraint in transmission networks that is an obstruction for market. participants to buy or sell energy. This issue can affect important changes on spot price and may increase it. [19]

- **Generation Reserves**

Having enough generation reserve is an important factor for electricity spot price, i.e. when demand increase suddenly if there is enough generation reserve capacity available as well as deliverable, consumers will be served. But if there is not sufficient generation reserve available, consumer would face with lack of received energy and therefore to make the balance between supply and demand electricity spot price increases. [20]

II . LITERATURE SURVEY

Angamuthu Chinnathambi, R., Mukherjee, A., Campion, M., Salehfar, H., Hansen, T. M., Lin, J., & Ranganathan, P. (2019) - The paper investigated a novel two-stage approach that combined the ARIMA model in Stage-1 and the resulting residuals as input to another forecasting method in Stage-2. The datasets used were drawn from the Iberian electricity markets. The results indicated a promising insight into the need for a focus on the residual improvement and training for forecasting the price markets. For the shorter duration of the dataset, ARIMA-SVM combinations outperformed other hybrid models. While, for a longer duration of the datasets, ARIMA-GLM performed better than the other models such as ARIMA, ARIMA-SVM, ARIMA-RF and ARIMA-LOWESS. **[01]**

Zhang, Q., Lu, J., Yang, Z., & Tu, M. (2019, March) - In this paper, we explore the relationship between electricity market and short-term load forecasting, and discuss different machine learning model for load forecasting. The influence features have been found and proved by experiment. Finally, the results show that the presented model can accurately forecast the daily load and the real-time load in the power spot market. Such short-term load forecasting can not only the extract features in the historical data, but also use the current time data to correct the load forecast at the next period. This model can apply to regional-wide node load forecasting, and in the future can assist the power retailer's quotation strategy and the power operator's node price setting. Obviously, with the reform of the electricity market, the integration of electric vehicles and renewable power generation, the uncertainty of power load will continue to increase. These uncertain factors can be specifically analyzed and integrated into the neural network.**[02]**

Yang, W., Wang, J., Niu, T., & Du, P. (2019) - In this study, an adaptive deterministic and probabilistic interval forecasting system is presented for electricity price multi-step forecasting in this study, which is not required to follow the assumption that future values in preprocessing will not affect the results of the model and will be a novel forecasting technique with high management practical value. Furthermore, the developed system can self-adjust at the data preprocessing stage and forecasting stage as long as future electricity price information is available, which successfully improves the forecasting performance in management practice. To prove its performance in electricity price forecasting, some experiments are also

presented in this paper. The results reveal that the presented system has the best forecasting performance among all benchmark models.**[03]**

Xu, S., Lin, J., Zhang, J., Sun, Y., Liu, L., Cheng, L., & Bao, Y. Q. (2019, November) - In this paper, bi-level optimization method is presented for bidding of retail electricity market. The main contribution of this paper may be summarized as following: 1. Bi-level optimization method is presented for block based (piecewise) bidding of retail electricity market. 2. Iterative-based optimization method is designed for lower layer optimization generators. The presented method is capable of solving nonlinear block-based bidding problem, and computationally efficient than Heuristic-based methods The future work may focus on the market rule designing based on the presented bi-level optimization method.**[04]**

Ahmed, A., & Khalid, M. (2019) - This paper presents the design of an adaptive EMS for a multitask FCHEV. The presented strategy utilizes the battery SOC, requested power, and maximum power and efficiency points of the FCSs to conduct the power split among four FCSs and a battery pack. The maximum power and efficiency points of the FCSs are continuously determined by using an online model composed of a KF integrated into a FCS semi-empirical model. The updated operating points are used by the strategy to decide on two essential things: first, ordering the stacks from young to old based on which they will be being used by the EMS. Second, determining the safe operating zone of each FCS, which is between maximum efficiency and maximum power points, to enhance their lifetime. The presented strategy first updates the order of stacks based on the information provided by the online modeling layer. Subsequently, it uses the minimum possible number of stacks to meet the requested power by switching on the FCSs one by one and operating them in their efficient zones. **[05]**

Ding, L., & Ge, Q. (2018, October) - This paper presents For forecasting electricity market clearing price, this paper considers the practical problems in the engineering field, establishes a model of Sage-Husa filtering which state transition matrix and observation noise covariance matrix are unknown, makes full use of electricity market transaction data to make predictions. Based on the adaptive, the forecast of the electricity market clearing price can accurately predict the electricity price of the electricity market, provide the predicted electricity price to the power supplier for reference. Generators can make a correct judgment on the current state of the electricity market, and formulate a quotation strategy in a scientific and effective way when bidding online. However, this paper does not consider the impact of the quotation behavior of the power producer on the electricity market to clear the electricity price, nor the impact of the power system blocking on the electricity price.**[06]**

Singh, A. K., & Parida, S. K. (2018) - In this work, it has been attempted to review the existing works on integration of DGs, an area that has seen tremendous research activity in the last few years. Several possible ways of classifying the works depends on different parameters and operating conditions with DGs have been discussed, and based on this, a classification of hierarchy has been investigated. The traditional industry dominated by large monopolistic and vertically integrated utilities has now given way to a healthy competitive environment in which a number of generation and distribution companies can trade freely and have a nondiscriminatory access to the transmission network. Because of rapid growth of population along with proportionate industrial development, the healthy competitive environment deteriorates with a gap in generation and demand. This can be counteracted by integrating DGs at sub-transmission or distribution level, which adds value to the system with proper planning. Review of the various DG allocation techniques for power flow analysis has been presented in this work. Proper allocation of DGs will be beneficial to environment and economically beneficial for utility and consumers. The passive distribution or sub-transmission network becomes active, when DGs are integrated into the system and hence, leading to some technical and economic issues. This survey is a step to identify the current state of the art in the area and some of the interesting research challenges**. [07]**

S.NO	YEAR	AUTHOR	REFE. NO	METHOD	RESULT
1	2019	Angamuthu Chinnathambi .et.al	[1]	ARIMA model	5.36 %
2	2019	Chinmoy, Lakshmi et.al	[2]	model of Sage-Husa filtering	0.0299%
3	2019	Zhang, Qipei et.al	[3]	multi-step forecasting in this study	38.6256%

4	2018	Hudson, Robert et.al	[4]	theoretical explanations to the EMH	42.11
5	2018	Singh, A. K., et.al	[5]	existing works on integration of DGs	
6	2017, June	Monteiro, Raul VA et.al	[6]	ANN model	10.3 7%
7	2017	Peesapati, VV et.al	[7]	PMU measurements across	
8	2017	Tahmasebifar, Reza et.al	[8]	including wavelet transform and MIbased feature selection	4.60 %
9	2017	Aien, Morteza et.al	[9]	Unscented Transformation (UT) method	
10	2016,	Panapakidis, Ioannis P., et.al	[10]	(ANN) based models	10.78%,
11	2016	Ghosh, S. et.al	[21]	PV inverter based	
12	2016	Kumar, N. et.al	[22]	volume-deviation-risk factor and the CVaR risk factor	5.627%
13	2016	e Silva, E. C et.al	[23]	Auto Regressive Moving Average model (ARMA).	

III. LOAD FORECASTING [24]

- The Forecasts, in particular have become important after restructuring of the power systems as many countries have deregulated their power system and turned electricity into commodity from necessity.
- Many countries are still in the process and soon electricity will be a commodity with players in all across global market. Load series is not only complex nut also exhibits several levels of seasonality.
- the prediction is not only depends on the previous hour load but also on the load of the same hour on previous day, and same denominations in the previous week.
- Various techniques and models have been developed for the forecasting the electrical load with varying degrees of success, but the still the models based on the linear regression scores over the other reported models.
- These models allow the system operators and engineer, physically interpretation of the components so that their behavior can be understood.
- Models based on Artificial Intelligence (AI) were also developed for forecasting of electrical load, such as expert systems, fuzzy inference, fuzzy neural models and neural network (NN) based models.
- Neural networks due to their intrinsic capability to learn complex and non linear relationships that are otherwise difficult by other conventional methods, have gained popularity among all artificial intelligence based Models.

IV. PRICE FORECASTING[25]

- "If With introduction of the deregulated electricity markets major emphasis is on maximizing the profits of the various market players.
- As far as forecasting is concerned electricity prices and load are mutually interlinked, due their dependability on each other and error in one will propagate to other.
- Non-storability, Seasonal behavior and Transportability are the major issues which makes electricity price so specific.

- These issues make it impossible to treat the electricity at par with any other commodity and forbid the application of forecasting methods common in other commodity markets.
- Electricity price forecasting can be categorized into three different categories based on time horizons.
- Short-term forecasting, medium-term forecasting and long-term forecasting Short term price forecasting (mainly one day ahead) will be mainly used by the market players to maximize profits in the spot markets. Knowledge of medium term forecasting will allow the successful negotiations of bilateral contracts between suppliers and consumer while long term forecasting will influence the decisions on transmission expansion and enhancement, generation augmentation and distribution planning.

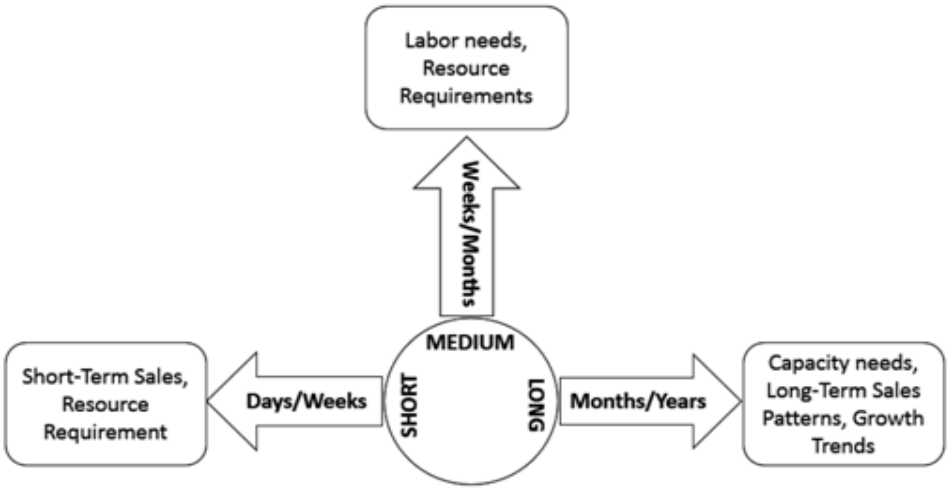

Fig 1.2 Types of forecasting

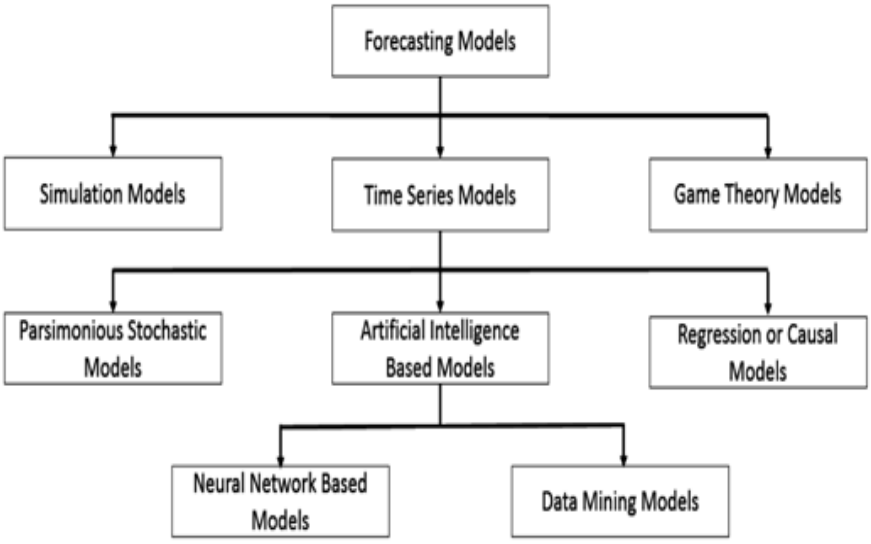

Fig 1.3 Classification of forecasting techniques

V. CONCLUSION

In this survey paper discuss on Electricity market clearing price forecast based on machine learning technical. The important outcomes of this paper are shown in the section of comparative analysis.

In this survey paper observe that the Electricity market clearing price forecast based on machine learning technical. Also most of the design Electricity market clearing price forecast based on machine learning technical.

In future design a better Electricity market clearing price forecast based on machine learning technical. That can improve all these problems in this communication area. In future try to design Electricity market clearing price forecast based on machine learning technical.

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