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A Comprehensive Review of Congestion Management in Power System

P. Manohar[1*], P. Rajesh[2], Francis H Shajin[3]

[1]Assistant Professor, Department of Electrical and Electronics Engineering,
Srinivasa Ramanujan Institute of Technology (SRIT), Anantapuramu, Andhra Pradesh, INDIA

[2]Department of Electrical and Electronics Engineering,
Anna University, Chennai, INDIA

[3]Department of Electronics and Communication Engineering,
Anna University, Chennai, INDIA

Corresponding Author*

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Abstract: In recent decades, restructuring has cut across all probable domains, involving the power supply industry. The restructuring has brought about considerable changes whereby electricity is now a commodity and has become a deregulated one. These competitive markets have paved the way for countless entrants. This has caused overload and congestion on transmission lines. In addition, the open access transmission network has created a more intensified congestion issue. Therefore, congestion management on power systems is relevant and central significance to the power industry. This manuscript reviews few congestion management techniques, consists of Reprogramming Generation (GR), Load Shedding, Optimal Distributed Generation (DG) Location, Nodal Pricing, Free Methods, Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Fuzzy Logic System Method, as well as Additional Renewable Energy Sources. In this manuscript a review work is performed to unite the entire publications on congestion management.

Keywords: Transmission network, congestion management, electricity markets, Distributed Generation (DG)

1. Introduction

As the population, industrialization and people's standard of living increase day by day, so does the demand for energy. For gathering end-user demand, transmission network can be limited [1]. At competitive electricity markets, a case of congestion at transmission network is contrasted with conventional electricity systems. Congestion occurs when necessary amount of power cannot flow on the lines based on certain limits [2]. If the overloading limits and capacities violent, congestion occurs on network. In [3], a literature survey on congestion management was provided that examines entire significant aspects, like its effect, problems as well as challenges. Various optimization methods and techniques for relieving congestion are also planned. In [4] the summary of congestion management technique at deregulated power system, consists of smart grid, and is discussed. It also looks at the congestion management system on different countries. Outcomes are evaluated to support of numerical data as well as employ various conventional as well as advanced congestion management techniques. The novel features of congestion on electrical system are suggested based on physical and system restrictions of transmission systems [5]. Thermal restriction has been examined in physical

**Corresponding author: manoharp0304@gmail.com*

restriction, while reliability, nodal voltage restriction, transient as well as dynamic stability is denoted as system limitation causing congestion at transmission network. It must be separated as probable, with guarantee security as well as stability of system [6]. If the outages occur regularly based on congestion, [7] the issue worsens and affects the quality of power and equipment at power systems. So, various investigations have currently paid more attention to address several challenges of congestion management at power system [8, 9].

This review work suggests a comprehensive as well as exhaustive review of congestion management in the power system. Initially, revision of congestion management techniques to distribution network may group with two divisions: direct as well as indirect control techniques. Direct control techniques consist of reconfiguring the distribution network, removing loads, and reducing distributed power output, reactive power control, as well as real power control. Indirect control technique has dynamic cost technique. In this review work, management of electricity system congestion is review as two features of transmission as well as distribution network that transmission congestion management techniques is split with two main ways of technical as well as market techniques. Depend on behaviour of transmission network; technology is intended primarily in application of phase shunt / shunt transformer as well as flexible AC transmission system (FACTS) methodology at congestion management. [10, 11] Market technique has correcting congestion or reprogramming the system (reduction of commercial contract as well as transmission plans, maximize as well as minimize of generator production, load shedding and implementation of interruptible load rights) pricing of congestion (depend on optimal power flow (OPF) actual-time node price / electricity pricing mechanism or basic mode regional electricity pricing mechanism), consists of Flow-Gate Right. This review work also looks at some congestion management methods, involving generator reprogramming (GR), load shedding, optimal Distributed Generation (DG) Location, nodal pricing, and free methods. Various optimization algorithms developed like genetic algorithm, particle swarm optimization, mixed integer nonlinear programming, shuffled frog leap algorithm, fuzzy logic system method, etc. are also discussed in detail and additional renewable energy sources to improve congestion. Countries such as Germany, European countries, and US have been illustrated in the review work. Lastly, congestion problem on transmission network and the distribution network should be taken into account in more depth in the future.

Based on the congestion management in power system various methods were presented and they are divided into three categories show a fig 1.

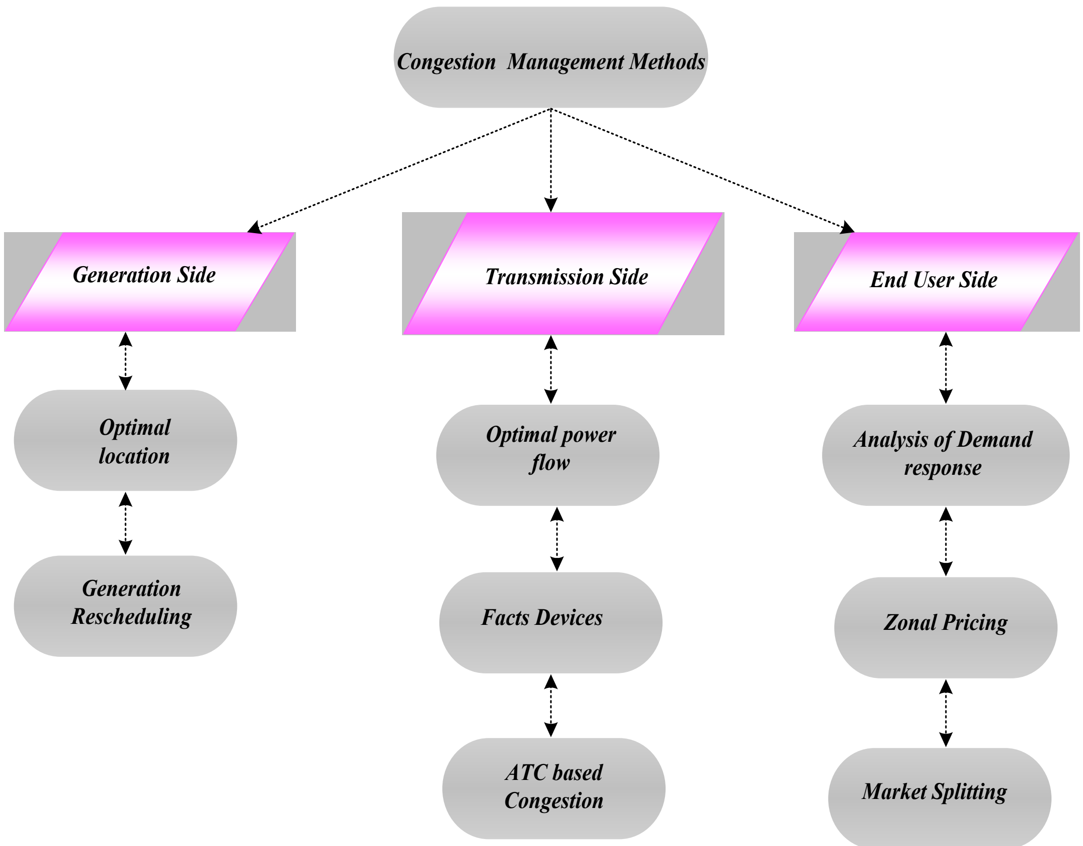

Fig. 1 - Categories of congestion management

Congestion in the system can cause wasteful operation and / or blackouts, a disruption of the interconnected system and disruptions in the systems. At emerging and competitive electricity markets, congestion management carries a significant role on economic, safe and stable operation of electricity system.

1.1 Objectives and Contribution:

(a) This review work suggests a comprehensive as well as exhaustive review of congestion management on power system.
(b) This manuscript creates a comprehensive summary of investigation outcomes of transmission resistance management on power market environment.
(c) The gird congestion management is separated into three aspects: transmission network, distribution network, and congestion pricing and allocation.
(d) The congestion management consists of broad range of connotations that is very difficult. It's directly linked with all features of market transactions and system operations.

2. Formulations of Congestion Management Problem

The formulations of congestion management issue in the power system are depicted under this section. Various minimization methods were derived in the accompanying section. [12]

2.1 Generation and Cost Minimization of Load Shedding (GCML)

The major objective of this section is decrease cost of load generation as well as load shedding. GCML equation is represented as follows [13-15],
Minimize,

$$GCML = \sum_{i=1}^{ng}\left(A_i + B_i(P_{Gi}) + C_i(P_{Gi})^2\right) + \sum_{K=1}^{nl}\left(A_K^{'} + B_K^{'}\left(P_{Shd,K}\right) + C_K^{'}\left(P_{Shd,K}\right)^2\right) \tag{1}$$

2.2 Load Shedding Minimization Amount

Sum of variation among minimum load as well as real power demand is known as load shedding as well as expressed it follows,

$$Minimize \quad P_{Shd} = \sum_{i=1}^{nbus}\left(P_{di}^{0} - P_{di}^{c}\right) \tag{2}$$

2.3 Load Served Error (LSE) Minimization

Objective function of LSE is described as below [14],

$$Minimize \quad LSE = \left(LS - LS^{0}\right)^2 \tag{3}$$

here the minimum LMS is denoted as LS^0, the load served is represented as LS.
The amount of load from the LSE is severed to voltage dependant of load as well as expressed below,

$$LS = \sum_{i=1}^{nbus} P_{l0}^{i}\left(\frac{v_i}{v_{0i}}\right)^{np} \tag{4}$$

The above equation (4) is measured as unique objective function known load served maximization (LSM).

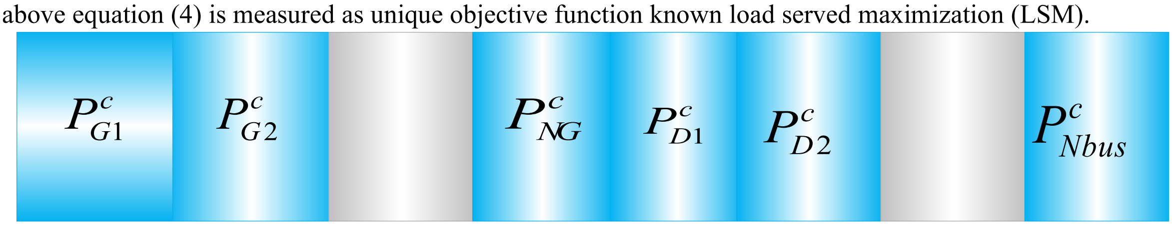

Fig. 2 - Control variables of congestion management

The objective function of LSE is not used as independent and it is used as supplementary. The objective functions are determined to control variables and congestion management control variables are shown in fig 2. Equality and inequality restrictions are required at following subsection.

2.4 Equality Restrictions

- **Restrictions of nodal power balance**

Equality restrictions include power stability of both real as well as reactive power. The equations of load flow for the equality constraints is denoted as below,

$$P_{Gi} = P_{Di} = v_i \sum_{j=1}^{nbus} v_j \left(G_{ij} Cos\delta_{ij} + B_{ij} Sin\delta_{ij} \right) \tag{5}$$

$$Q_{Gi} = Q_{Di} = v_i \sum v_j \left(G_{ij} Sin\delta_{ij} - B_{ij} Cos\delta_{ij} \right) \tag{6}$$

where the differences between voltage phase angle of bus *i*, *j* is represented $\delta_{ij} = \delta_i - \delta_j$.

2.5 Inequality Constraints

The operating limits of various constraints were presented in the constraints of inequality Generation Constraints

In generation constraints, the maximum and minimum limits are restricted in the output of generating units. The minimal and maximal constraints of generating restriction is denoted as below,

$$P_{Gi}^{Min} \le P_{Gi} \le P_{Gi}^{Max} \tag{7}$$

Based on the generator constraints, the reactive power limits are given as below,

$$Q_{Gi}^{Min} \le Q_{Gi} \le Q_{Gi}^{Max} \tag{8}$$

The voltage limits of generator bus is expressed as,

$$v_{Gi}^{Min} \le v_{Gi} \le v_{Gi}^{Max} \tag{9}$$

- **Control Variable constraints**

The limits of control variable constraints are expressed as

$$P_{Gi}^{Min} \le P_{Gi}^{c} \le P_{Gi}^{Max} \tag{10}$$

$$P_{Di}^{Min} \le P_{Di}^{c} \le P_{Di}^{0} \tag{11}$$

where in the normal state the active power load demand is represented as P_{Di}^{0} and the amount of load is denoted as P_{Di}^{Min}.

3. Congestion Management Methods of Generation Side

3.1 Generation Rescheduling of Congestion Method

Congestion management in the power system, the generation rescheduling is one of the most used methods. In [16], a load generation and load shedding reprogramming method to address congestion to realistic voltage depend on load modelling. As primary goal of the method is to reduce the cost of generation, load shedding, as well as load detection error, to increase demand response (DR) and load served (LS). For congestion management a quasi-based thermal rate of transmission line is presented in [17]. In a specific time, frame, the cost of congestion was reduced by reprogramming the generation and elimination of load, is also employed with resolve congestion management problems. Optimization issue consists of optimal generation rescheduling as well as load shedding method to reduce the cost of congestion management at specific time interval. The congestion clearing time is split at some subsequent intervals intended to account for loads as well as power system differentiations due to reprogramming procedure. System operators could use the established technique to tailor the congestion management procedure in real time with respect to power system loads as well as generations or system configuration differentiations due to reprogramming as well as load shedding process. In [18], the method of optimization to congestion management incorporate computation of two factors such as generator sensitivity factor (GSF) as well as bus sensitivity factor (BSF). The optimal position of PSHU is recognized employing BSF value as well as amount of participating generator to congestion management with reprogramming their results is demonstrated employing GSF value. PSHU impact at managing transmission congestion has been researched that additional decreases cost of congestion as well as perform system security.

3.2 Sensitive Factor Based Methods

In [19], transmission line boundaries prevent power transfers as well as cause congestion, highly eliminate the efficiency of systems as well as maximize power transmission cost. Various techniques, congestion may be efficiently reduced to construct a novel transmission line or maximize capacitance of innovative line among congested areas. A technique cause modifies in susceptance as well as increase in line capacity among nodes. So, sensitivity system with differentiations at parameters becomes significant based on operation as well as development. In [20], a recently evolved technique as well as tool with agreeably and capably remedies various types of congestion at power grid. The approach presented has three main steps: building the grid model, recognize technical factors influence congestion, formulation and resolve an optimization problem to remedy congestion with changing real power set points of power plants. Optimization methods too technically as well as economically optimized patch the patch is accessible. The manuscript focuses on evolving a solution examining technical as well as financial objectives to get an optimized solution. The contribution and control scheme involved in the congestion management method in end user side is shown in table 1.

Table 1 - Congestion management methods in Generation Side

Ref. No	Control scheme	Contribution
[16]	**Control Scheme:** Novel method to congestion management employing generation reprogramming as well as load shedding	**Contribution:** For resolving the proposed congestion management issue
[17]	**Control Scheme:** The optimal real-time transmission congestion management algorithm at aggressive electricity market depends on actual-time measurements at intelligent power system.	**Contribution:** Thermal rate of transmission line is computed as well as employed to resolve congestion management optimization issue at real time.
[18]	**Control Scheme:** New competent method to congestion management	**Contribution:** To guarantee congestion free transmission network destroying less system security.
[19]	**Control Scheme:** Congestion relief is investigated based on line susceptions and capabilities.	**Contribution:** Reduce the effectiveness of systems as well as maximize power transmissions cost.
[20]	**Control Scheme:** flexibly and efficiently remedies various types of congestion at power grid	**Contribution:** Formulate and solve an optimization issue through remedy congestion to changing real power set points of power plants.

4. Congestion Management Methods on Transmission Side

4.1 FACTS Device Based on Congestion Management

Flexible AC Transmission System Device (FACTS) is employed to automatic power compensation at transmission lines. As [21] maximizes load capacity of transmission lines as well as decreases power loss. It consists of various techniques to get optimal location, size, as well as cost of FACTS devices to alleviate line congestion. Multiple as well as multiple ways of FACTS device is employed to get an answer to optimal power flow on congested lines.

At [22], an indication of congestion management employing FACTS drivers planned. FACT controller is split at two categories like first generation as well as second generation. At initial generation, fact controller has capacitance as well as reactance, when at second generation the advanced controller that is broadly employed; to voltage source as well as battery storage system is planned. In [23] a rapid contingency ranking technique (RCRT) is employed to contingency examination. Optimal assignment of TCSC made depend on line utilization factor (LUF) as well as fast voltage stability index (FVSI). The algorithm of Krill Herd (KH) is employed with resolve multiple purpose of issues.

Kumar suggestion [24] focuses mostly at reduction of total voltage deviation, the safety boundaries as well as loss of real power systems means of optimal positioning of interline flow controller (IPFC). To optimal IPFC location employing Line Disparity Utilization Factor as well as algorithm of FA optimization to decrease congestion on power transmission lines is employed. Outcome is obtained using various conditions of load. An outcome demonstrates that optimal placement of IPFC decreases congestion on transmission lines.

In [25] methods have been proposed to optimal TCSC load to decrease congestion at transmission lines. The major objective is to reduce TCSC implementation costs. [26] Optimal location is demonstrated based on a sensitive factor. PSO-TVAC optimization method is get to implement maximum quality solution.

In [27], congestion management is crucial to obtain well-organized as well as reliable operation of power system, therefore a significant task to any transmission of system operator. Currently, different TSOs implement various congestion management methods. These manuscripts, we believe two market methods. At initial, it examines transmission restrictions at previous day at real time. These methods are pertinent with centralized markets. Next method examines transmission restrictions at RT, pertinent with decentralized markets. We quantitatively contrast management of congestion at market methods, on power system to thermal as well as wind generation, since we differ (i) proportion of thermal units, (ii) level of wind penetration (iii) level of congestion.

In [28], a main concern at deregulated electricity market is transmission prices, congestion management as well as available transfer capacity (ATC) which must modify. Between these fascinating challenge, must be interrogate to implement ensured open access transmission service denotes ATC. ATC perform is to add broadcast services or use multiple FACTS device. These documents, anxiety are in corporation of FACTS, semiconductor-depend on control device through recover ATC of transmission system. Numerous FACTS devices like STATCOM, SSSC as well as UPFC are modelled to equations of power flow as well as optimal configure parameters of FACTS employing Particle Swarm

Optimization (PSO) method that improves ATC at deregulated electricity environment.

In [29], a novel method depends on technique of AC power flow for congestion management is evolved to support Flexible AC Transmission System (FACTS) devices at power system. Depend on operation, the Unified Power Flow Controller (UPFC) employed to learn versatile device at family of FACTS. UPFC is supposed to be positioned optimally depend on few previous techniques. UPFC effect is demonstrated in formation of conglomerates / congestion zones as well as reducing actual power reprogramming obligation for congestion management. A set of customized actual power transmission congestion distribution factors (PTCDFU) is maintained at attendance of optimal location UPFC, used to group / zone formation and congestion management.

In [30], multipurpose particle swarm optimization method (MOPSO) is employed to manage transmission congestion examining demand response programs (DRP) as well as generation reprogramming. Total cost of operation / DR, emissions, and increased load on transmission line is objective functions of this issue. DRP maximizes operator's power of option regarding the participation of little consumers at demand reducing.

4.2 Distribution Generation Based

In [31], a technique of addressing congestion to insert optimal Distributed Generation (DG) capabilities at transmission line. Multiple targets become a unique target to reduce optimal distributed generation capacitance to congestion management. Multiple targets like actual power loss, voltage deviation, line capacitance, as well as investment cost are measured. The established topology employs FPA to attain better possible DG that works at unity or with a power factor of 0.9. Outcome is contrasted to other algorithm such as genetic algorithm (GA) as well as PSO validate FPA provides enhanced outcomes based on calculation efficiency, trait as well as characteristic.

In [32] an idea of introduce DG as well as DSTATCOM at system is obtainable with maximize voltage profile, decrease energy loss as well as maximize economic merits. Device is located according to voltage stability index to get optimal outcomes examining surrounding properties. Reference, Peesapati et al. (2018b) established concept to manage congestion employing optimal distributed generation capacitance. These documents, the multiple objectives become a unique objective function as well as DG is placed at various locations to get best result to relieve congestion.

In [33] suggest application of a new algorithm that depends on modified sine-cosine method to resolve issue of optimal power flow. It extremely coupled nonlinear restricted optimization issue. MSCA goals to decrease calculation time to enough performance to get optimal solution as well as viability. A fundraising flight is included with original Sine-Cosine algorithm improve capability to focus at optimal as well as prevent local optima. Minimizing the amount of search agents depend on target function speeds up the MSCA.

In [34] a market cleaning model is suggested to smart distribution systems. Several methods of Distributed Energy Resources (DER), as distributed energy storage, distributed generators, microgrids, as well as burden aggregators, may participate at daily distribution tier electricity market. Taking into account the Volt / VAR control of the system, the reconfiguration of the network and connections to extensive market, and the optimization replica is constructing to obvious daily market, via those marginal prices of location of distribution to active power and reactive power.

In [35] assignment of grid scale energy storage systems may consist of important impact at level of presentation enhance of distribution networks. These documents establish the method to optimal allocation of distributed ESS at distribution networks at same time minimize voltage deviation, flicker, power loss, as well as line load. Optimal ESS allocation researched to PQ inoculation (examining changeable power factor in ESS delivery) as well as outcome is compared based on performance as well as improvements at power quality.

[36] The dynamic rate method is designed to distribution system operator (DSO) via ease congestion, which can occur at distribution network to great diffusion of distributed energy resources (DER). Uncertainty management denotes necessary to decentralized DT technique since DT determined depend on optimal daily energy planning to plan parameters, like daily energy prices and energy needs that may be variant as parameters employed to aggregators.

In [37], a dynamic rate method depends on distributed optimization to congestion management at distribution networks to great diffusion of EV as well as heat pumps HP. DDT technique uses a decomposition depend on optimization technique for aggregators with openly involved at managing congestion that provides greater certainty as well as transparency compared with normal DT technique. DDT technique, aggregators divulge their last aggregate plan as well as abide by plan through operation. To establish an equal general optimization, it shown that DDT technique can reduce the total cost of power consumption as well as cost of line loss that is variants as existing decomposition like multi-system methods agents.

Congestion management denotes main enablers of intelligent distribution systems in [38], distributed energy resources is used at grid control with allow cost-effective Distributed Generation (DG) grid interconnection as well as best use of network property. Main objective of congestion management represents avoid voltage violation as well as network overload. Congestion management algorithms may be employed to optimize state of the network.

At [39] present, Distributed Generation (DG) depend on conventional energy sources as well as renewable energy sources (RES) has important task worldwide. Energy policies represent distributed energy resources, like energy efficiency; maximize amount DG installation as well as RES preparation. It must see, which increasing rates of the countries' cargo is maximized quickly. Though, the ungraceful management of alternative energy sources may generate various strains at electrical grid. To overwhelm the issue, DGs is better option to manage required energy.

At [40] Distributed generations give with diversity of supply, and to the competitiveness of electricity market. Electric power supplies as well as charging employers search for optimally assign / use energy to increase merits. Though, increase social welfare must be only goal, as line congestion may lead with serious issues. These documents establish a completely distributed solution with optimal DC power flow to congestion management. Objective denotes increase social welfare, when maintain a balance among supply and demand as well as relieve transmission line congestion.

In [41] Large-scale distributed energy resources, like asymmetric EV right of entry with minimum-voltage distribution systems, can origin safety issues, consists of line congestion, voltage violation, as well as 3-phase imbalance. These manuscripts, a congestion management technique to minimum-voltage active distribution networks are established. Soft open point, flexible power, is examined means of straight control to resolve congestion issue initially. Semi-defined scheduling model is construct depend on symmetric constituent technique to optimize operation method, which may be powerfully resolve with assemble the demands of quick centralized control. For ensuring charging behaviours of the flexible charge denoted to EVs, it is considered a suitable market mechanism to unbalanced minimum voltage network. Despite the linear approach and sensitivity analysis, a flexible charge pricing model is established that takes into account the effect of grid loss, voltage variation, three-phase voltage imbalance, as well as line overload at price as marginal location of distribution.

In [42] Dynamic Subsidy represents location price paid to Distribution System Operator with customers with transfer power consumption at designated times and nodes. It promises as demand side management as well as congestion management. These manuscripts establish novel DS technique to managing congestion at distribution networks, which consists of market mechanism, mathematical formulation via two-level optimization as well as resolves the optimization to adjusting the restrictions as well as linearization.

4.3 Optimal Power Flow (OPF) Management Depend Congestion Management

In [43] denotes DC OPF-based technique to improve congestion as well as perform social as well as financial merits when obtaining balance of generation require at deregulated network. The author established a novel method, i.e. Modified Sin Cosine Algorithm to solution of optimal power flow. In [44] Suggest Critical Constraint Violations Identification View (CCV). CCV is mentioned to solve the Safety Constrained Optimum Power Flow (SCOPF) support device take active corrective action. The management of static security restrictions is represented exactly to security restrictions of optimal power flow. It separated at non-critical as well as critical restrictions; here non-critical restriction is control with preventive controls.

In [45] addresses a major transmission network congestion issue at deregulated power systems; here transmission network is alleviated disrupting less previous dealings. Thyristor controlled series capacitor denotes alternatives with decrease as flow at highly charged lines, outcome at higher load capacity and meets contractual requirements to control the flow of energy at network. Distribution Generation Units (DG) is other alternative to compensate to energy deficit on the load bus to reduce the energy flow at greatly loaded lines. TCSC significant cost as well as maximal reimbursement to DG unit on cargo buses, essential to discover its optimal location at system, a technique has been suggested to decide optimal location of devices, line relief sensitivity index methods transmission and real power flow. The OPF depend on congestion management (CM) method is performed to reduce production cost as well as alleviate transmission network to TCSC / DG unit. The nOPF depend on CM issue performed at 26 bus power system network as well as solution is obtained to three conventional techniques. Investigational outcomes demonstrate which interior point (IP) technique denotes optimal economical solution.

In [46], the proper assignment of IPFC may greatly perform the issue of transmission line congestion. This manuscript establishes disparity line utilization factor (DLUF) to optimal IPFC assignment with control congestion at transmission lines. DLUF demonstrates variance among Mega Volt Ampere utilization percentages to every line associated with similar bus. IPFC is located on lines to maximal DLUF. Multi-purpose function has reducing real power loss, minimizes whole voltage deviations, minimize safety margin, as well as minimize installed capacitance IPFC is measured to optimal optimization of IPFC employing various evolution algorithm.

4.4 ATC Based on Congestion Management

In [47] suggests OPF as well as ATC depend on congestion management method to TCSC portion. GSA implementation method supports with decrease congestion costs. This method gets to offer best outcomes compared to few conventional techniques.

ATC is demonstrated

$$ATC = TCC - TRM - \{ETC + CBM\} \tag{12}$$

Here, available transfer capability is expressed as ATC , TCC is expressed as total congestion rent value.

TTC: It is categorized by being highest gauge of energy that may be exchanged through system when meeting requirements of entire security.

TRM: To categorize as gauge of interchange ability significant to ensure, which interrelated transmission arrangement is in safe range of vulnerabilities.

ETC: It refers with exchange capacity of framework, which should maintain to exchanges that dedicated.
BM (Capacity Benefit Margin): To gauge the exchange capacity of substances that are served in the heap to ensure access with generation as interconnected frameworks to satisfy the unwavering quality needs of the generation.

To specify terminal objective to satisfy growing interest at energy connections as well as maintain adequate normal energy advertising activity, power transmission capacity must be maintained. Some method is made to update ATC in existing transmission control networks.

At [48] point of view operational planning, these documents focus on evaluating crash of FACTS control improving available transfer capacity. The scientific advantages of FACTS methodology at maximizing ATC discussed. Optimal ATC improvement method depends on power flow is formulated to attain maximal power transfer as specified interface to FACTS control.

In [49], congestion is a very important concern to independent system operator at deregulated energy market since carries extra cost as well as represents a threat of security of electrical system. To alleviate congestion, this manuscript suggests Optimal Power Flow as well as Available Transfer Capability (ATC) depends on technique to handover Thyristor Controlled Serial Compensator (TCSC) employing Income Contribution method. Congestion depends on marginal price of location. DC power transfer distribution factor is employed with calculate ATC at surrounding of bilateral transaction. The contribution and control scheme involved in the congestion management method in transmission side portrays on Table 2.

Table 2 - Congestion management methods on Transmission Side

Ref. No	Control scheme	Contribution
[22]	**Control Scheme:** Undertake a comprehensive review at optimal location of various FACTS	**Contribution:** To provide knowledge about various FACTS devices as well as enhance at field of optimal location
[23]	**Control Scheme:** TCSC optimal location as well as generator of optimal tuning	**Contribution:** Optimal power flow (OPF) denotes perfect solution via issues
[24]	**Control Scheme:** IPFC optimal location depend on DLUF	**Contribution:** To perform transmission line congestion issue greatly.
[25]	**Control Scheme:** Optimal congestion management method at deregulated electrical market employing TCSC optimal location	**Contribution:** To get optimal location TCSC
[26]	**Control Scheme:** Thyristor controlled series compensated devices	**Contribution:** Placed to congestion management at electrical system
[27]	**Control Scheme:** Congestion Management in Electricity Markets	**Contribution:** To preserve well-organized as well as reliable operation of power system other practical network also.
[28]	**Control Scheme:** Operational setting of FACTS devices	**Contribution:** To improve transmission system ATC
[29]	**Control Scheme:** Congestion management employing FACTS controller at power system	**Contribution:** To perform transmission system ATC
[30]	**Control Scheme:** Operational setting of FACTS devices	**Contribution:** Developed to congestion management support of FACTS devices at power system.
[31]	**Control Scheme:** Multi-objective congestion management examining optimal capabilities of distributed generations	**Contribution:** To eliminate congestion at transmission lines of the bulk energy system.
[32]	**Control Scheme:** Distributed generation integration as well as distributed static compensator	**Contribution:** To decrease search space and computational load
[33]	**Control Scheme:** Optimal power flow solution in power systems	**Contribution:** To solve issue of optimal power flow (OPF)
[34]	**Control Scheme:** A market cleaning model to smart distribution systems.	**Contribution:** Evolved to congestion management to the

		support of FACTS devices at power system
[35]	**Control Scheme:** Optimal portion of ESS dispersed across distribution networks.	**Contribution:** At the same time reduce voltage deviation, flickering, power loss, as well as line load
[36]	**Control Scheme:** Dynamic tariff (DT) technique is intended to distribution system operator (DSO)	**Contribution:** To improve congestion that can occur at distribution network to support penetration of distributed energy resources (DER)
[37]	**Control Scheme:** Distributed optimization depend on dynamic tariff technique to congestion management at distribution network	**Contribution:** To reduce total energy expenditure cost as well as line loss cost
[38]	**Control Scheme:** Hierarchical as well as dispersed congestion management idea to outlook distribution network	**Contribution:** Aims to operate network at minimal costs when maintaining at satisfactory network condition
[39]	**Control Scheme:** Distributed classification as well as planning distribution at deregulated electrical market.	**Contribution:** To better integrate flexible demand-side, demand-side management to DG
[40]	**Control Scheme:** Distributed solution at optimal DC power flow to congestion administration	**Contribution:** For increasing social welfare, obtain balance among supply as well as require mitigate congestion on transmission line.
[41]	**Control Scheme:** Low voltage congestion management technique active distribution networks	**Contribution:** To solve as congestion problem
[42]	**Control Scheme:** Dynamic subsidy technique to manage congestion at distribution networks	**Contribution:** To solve the optimization by tightening the restrictions as well as linearization.
[43]	**Control Scheme:** Distributed solution at optimal DC power flow to congestion Administration	**Contribution:** For maximizing social welfare, when maintaining balance among supply and demand the relief of transmission line congestion.
[44]	**Control Scheme:** Static security restriction management, formulate to security constrained optimal power flow	**Contribution:** It may support design and activate optimal corrective actions.
[45]	**Control Scheme:** Important problem of transmission network congestion at deregulated energy systems,	**Contribution:** To reduce the cost of production and mitigate transmission network congestion to TCSC / DG unit.
[46]	**Control Scheme:** Congestion Management of Power System to Controller of Interline Power Flow	**Contribution:** For controlling congestion on transmission lines.
[47]	**Control Scheme:** OPF as well as available transfer capability techniques	**Contribution:** To assign a TCSC employing congestion lease payment
[48]	**Control Scheme:** Improvement of transfer capacity employing FACTS devices	**Contribution:** The analysis of crash of FACTS control at improving the available transfer capacity (ATC).
[49]	**Control Scheme:** Placement of TCSC to congestion control at deregulated power system	**Contribution:** To direct congestion at electric pool market.

5. Congestion Management Methods in End User Side

5.1 Market Based on Congestion Management

In [50] established a comprehensive contingency analysis one day ahead. Dynamic rate idea has been performed at customized Roy Billinton Test System. To originate this technique may employ at great circumstances here innovative non-relaxed dynamic rate model cannot be feasible.

In [51], transmission congestion management act as task at deregulated energy markets. In order to replica as well as resolve these issues correctly, the power system voltage as well as transient constancy restrictions must be examined via prevent obtain vulnerable power system to minimum constancy margins. Congestion management denotes model multi-objective organization issue at manuscript. The established method consists congestion management cost, the voltage constancy margin, as well as transient constancy margin denotes multiple challenging objectives. In addition, an effectual novel method to solving Multi-objective Mathematical Programming depend on normalize usual restriction method is suggested for resolving multi-objective implementation issue of congestion management that may create an effectual as well as well-organized Pareto border.

In [52] suggests a traffic control system, which may operate independently to handle several recurring, non-recurring congestion limit conditions, traffic signal priority, and downstream blocking conditions to perform vehicle productivity as well as competence of general traffic network.

In [53] Demand response may be count an effectual technique of congestion management at power systems. Though, designating optimal buses to implementation of DRP denotes major ways to electricity system operation. These manuscripts, novel procedure is evolved that optimal positions as well as times for DRP performance is demonstrated. Optimal bus is recognized depend on PTDF, available transfer capacity, as well as issue of DDCOPF. Application of evolved technique outcome at reduction of line congestion, the increase in customers as well as advantages of independent system operator (ISO), the performance of characteristics of load curve, the prevention of interruptions of line and blackouts as well as subsequently maximize network reliability.

In [54], capacitance challenges is increasing at low-voltage (LV) distribution networks based on quick propagation of dispersed energy resources as well as maximized electrification of burden. Conventional network reinforcement method may not reach optimal based on inherent uncertainties connected to DER.

In [55], the operation of the power system at post-restructuring era face various methods: transmission congestion occurs regularly, security denotes extra discouraged to precedent, emissions decrease at significant issue as well as irregular renewable power generation resources is extensively promote. These manuscripts are intended with resolve the challenges at multi-objective framework optimization. Established process consists of two steps: at priori step, the cost of transmission congestion management as well as emissions is exchanged through a established stochastic increased electronic restriction method that produces a unmanaged solutions. At ex-post stage, a solution is selected considering the security of the power system. To purpose, two steps are established: at initial step depend on established management idea, combination of data wrap evaluation suggested to Charnes, Cooper, as well as Rhodes (CCR-DEA), cross-efficiency method, evaluation is implemented. For robustness choose the robust super competent solution.

At [56] intelligent grid surroundings, Demand Response Resources denote power system resources may successfully contribute as well as enhance the presentation of electrical systems. Congestion management denotes technological challenge at DRRs play an important task. Earlier, congestion management was implemented without taking into account doubts of the electricity system. Consequently, stochastic congestion management is established of compensation among DRRs as well as load shedding, therefore interruption of transmission lines as well as measured generating units.

At [57] aggressive electricity market, congestion denotes serious economic as well as consistency anxiety. Congestion denotes general issue faced to self-governing system operator at open access electricity market. These articles suggest a dependable as well as well-organized metaheuristic method for solving the congestion issue. The established method of current work uses the firefly algorithm (FFA) to mitigate the congestion of transmission grid at pool-based electricity market through reprogramming of active energy from generators. FFA denotes novel metaheuristic method depend on intermittent patterns as well as behaviour of fireflies. A number of important safety restrictions, like bus voltage as well as line load, is considered as account when trade to congestion issue.

In [58], previous frequency control framework at power systems denotes challenge to minimum inactivity as well as volatile power injection. To establishes the novel framework to control frequency as well as congestion management. To formulate a utilization issue, this rebalances power, restores ostensible frequency, restores fluxes between areas, as well as keeps line fluxes under restrictions, which reduces cost control. Cost may square deviations of reference generation, reducing interruption of final optimal shipment. To maintain the safety of the system interfering less via operation of market. Derive a primary-dual to resolve this utilization, designed a totally decentralized main frequency control require less to explicit communication between participate agents, as well as dispersed unified control that integrate main as well as secondary frequency control as well as management of congestion.

5.2 Demand Response Management

It allows users with participate at power of market. It consists of two main methods: EDRP as well as another one forwards the generations. DR is alienated at two methods: incentives-depend as well as time-depend. EDRP belong with incentive. Large customers need to decrease a part of electricity contribute. Consumer incentive will be paid with consumers. Based on model is planned at aspect [59].

In their manuscript, they established a method to congestion via combining DR as well as FACTS. It did as two steps at market glade method. At initial method, ISO authorizes the market price employing the social welfare behaviour, as well as next step, network restrictions regarding with congestion management is measured. Optimal coordination of DR as well as FACTS devices to conventional generators denotes emphasize of these manuscript [60].

$$l(i) = l_0\left(\frac{p(i) + CR(i) + Pen(i)}{P_o(i)}\right)^{e(i)} \tag{13}$$

Here, demand response program after customer demand is expressed as *l(i),* the demand response program before customer demand is expressed as $l_o(i)$. Electricity cost is expressed as *p(i),* for every unit of load decrease, to customers the paid incentives is expressed as *CR(i)*, the penalty requested from reduction level is expressed as *Pen(i)*, the self-elasticity of load is expressed as *e(i),* the implementation of demand response to market price is expressed as $P_o(i)$.

6. Optimization Techniques

In [61], a new algorithm to congestion management is suggested through the installation of TCSC examining voltage corrective methods. Bee Colony Optimization (BCO) is employed to TCSC optimal size.

In [62], established IGWO optimization method to manage congestion at overload and line interruption conditions of 25% and 50%. The outcomes are compared to original GWO as well as another conventional method to validation. Mathematic creation to possibility evaluation and optimal position to Flexible AC Transmission Systems Controller (FACTS) is planned at manuscript. The optimization techniques show a fig 3.

In [63] Converse the novel optimization method called MO-GSO to multi-target congestion technique. Two methods is measured, that is, bidding as well as bidding less cases, various purpose functions is considered. This algorithm is also useful for generating the Pareto Optimal Set Solution to congestion management.

In [64] suggested a novel Saturn bird optimization meta-heuristic algorithm (SBO) to manage congestion at dispersed power system. Generator restructuring method employed by decrease cost of congestion as well as meet entire restrictions. The outcomes of established method are compared to another like random search method, SA, PSO, FA, hybrid particle swarm optimization, differential progression as well as RCGA. SBO get to provide greater outcomes. Multi-objective characteristics such as cost as well as loss are just as important when testing the system.

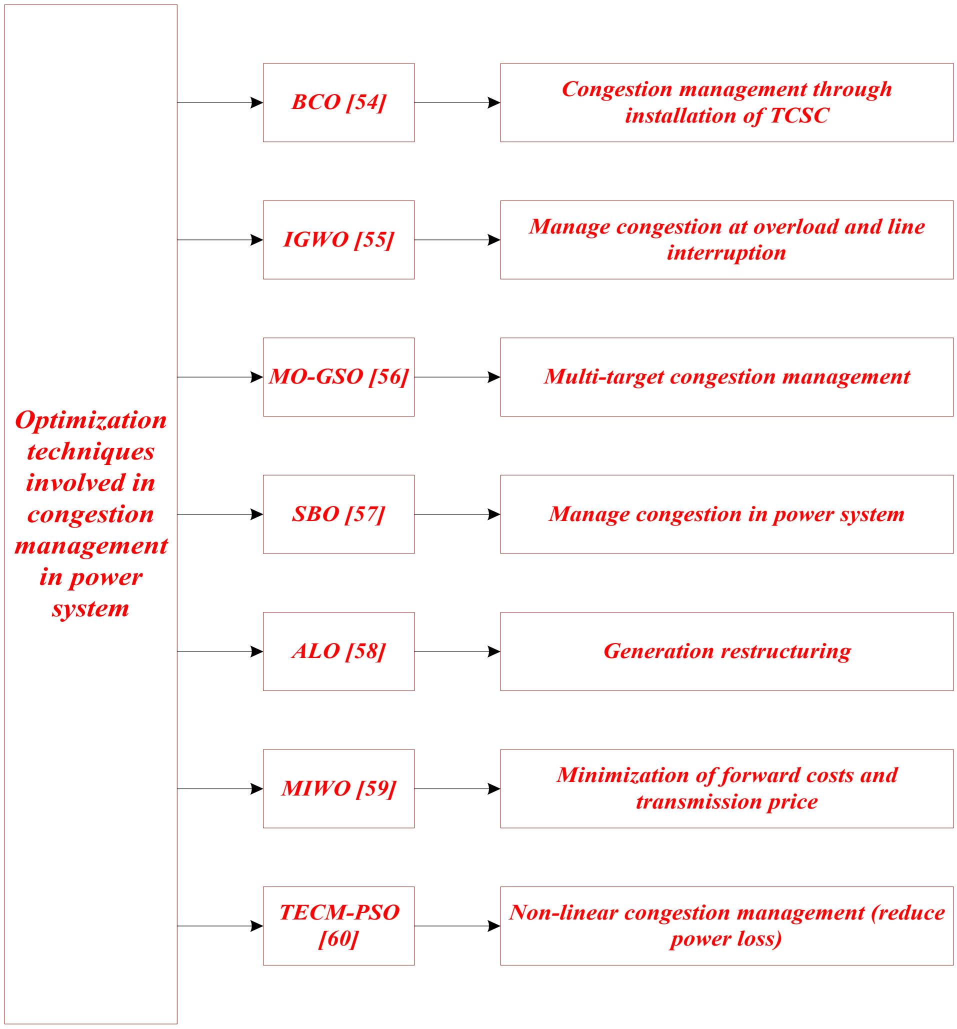

Fig 3 - Optimization Techniques

In [65] suggests the algorithm of Ant Lion Optimizer (ALO) to CM using generation restructuring. The bus voltage as well as line load is engaged as safety restrictions for study. Outcomes depend on ALO algorithm is contrasted to PSO, DE, BA, SA, RSM, CBA, EP, FPA, RCGA, FFA as well as HPSO. At the minimization of forwarding costs and transmission prices is measured as major objective function. MIWO measured that represents biologically inspired method. MIWO get to deliver best outcomes to Co-Evolutionary Particle Swarm Optimization method, PSOTVAC, as well as Time Variable Inertia Weight method. It denotes new method to mitigate congestion, decrease cost of reprogramming as well as power loss. An advanced adaptive particle swarm optimization algorithm for twin extremity chaotic maps (TECM-PSO) has been utilized for non-linear congestion management.

7. Issues and Challenges

Congestion management denotes difficult role to maintain the safety as well as constancy of the system. The major challenges on managing demand is managing performance, uncontrolled loads and climate change problems based on inadequate market structure, lack of motivation and infrastructure. It consists of various problems and dispute at congestion management that are highlighted as follow:

1. As it is well known, the better way to direct congestion is to reprogram active power, but real power planning changes reactive power flows can cause other electric system issues. Consequently, numerous times, reactive power is established together to reprogramming of real power that maximizes complexity of dispatch issue. Due to incomplete time, load will be eliminated depend on available contracts as well as reprogramming of generation.
2. In today's smart grid initiatives, accessibility of DG sources may have employed, though its size and proper location is important. Congestion should be managed quickly to avoid security as well as stability issues consequently a quick as well as reliable technique is required.

3. Numerous conventional and unconventional optimization systems are used for solving congestion management (CM) issues, but appropriate intelligent calculation systems are still required that may be robust to system changes.
4. At practice, CM represents complex issue to multiple objectives and, consequently its modelling is significant. It has numerous systems proposed at bibliography that use few approximate systems for solving this issue rapidly but lack the local optimum. Several sensitivity factors as well as power transfer distribution factors (PTDFs) is established, due to stressed condition, accuracy of these techniques denotes main concern. Precise modelling maximizes calculation burden, as well as better balance is needed among estimation as well as precise modelling issue.
5. There may be FACTS devices in the system and their operation may be employed to alleviate congestion at systems. However, its cost of operation as well as another financial matter should be considered. Installing these devices can mainly perform system stability, security, etc., so use to congestion may be measured secondary purpose.
6. It has numerous devices that may be utilized for controlling congestion, but the cost of control action can be another problem and therefore optimal control action and coordination must be assumed.
7. It consists of market-based congestion management methods. Transmission network organization as well as transmission rights may be employed appropriately as managing congestion.
8. Most of the processes assume static congestion management processes that use static classification of devices. Dynamic classification of transmission lines may be assumed.

The contribution and control scheme involved in the congestion management method in generation side shows a table 3.

Table 3 - Congestion management methods in End User Side

Ref. No	Control scheme	Contribution
[50]	**Control Scheme:** Comprehensive method to daily management of distribution network congestion through great penetration of distributed energy resources (DER).	**Contribution:** Resolving congestion more effectively as well as similar time guarantees, which congestion management prices is acceptable level.
[51]	**Control Scheme:** Transmission congestion management denotes a task at deregulated energy markets.	**Contribution:** To resolve transmission congestion management issue
[52]	**Control Scheme:** Relief of congestion to trade-off among require response resources as well as load shedding	**Contribution:** To recover presentation of electric systems.
[53]	**Control Scheme:** CM in deregulated environment	**Contribution:** It helps at eliminate line congestion to reduce reprogramming cost.
[54]	**Control Scheme:** Unified Framework to Frequency Control as well as Congestion Management	**Contribution:** Cost may square deviations of orientation generation, reduce interruption of final optimal dispatch
[55]	**Control Scheme:** An incorporated actual-time traffic signal to traffic signal precedence, occurrence recognition as well as CM	**Contribution:** To demonstrate limit conditions of entire inbound as well as outbound associations.
[56]	**Control Scheme:** Demand response may count as effectual technique of CM at power systems.	**Contribution:** A novel procedure has been evolved whereby an optimal location as well as times to DRP implementation is demonstrated.
[57]	**Control Scheme:** Demand response to real-time congestion management	**Contribution:** To obtain the costs incurred to overcharging.
[58]	**Control Scheme:** Congestion management to emission decrease at power system	**Contribution:** Developed to congestion management via support as FACTS devices at power system.
[31]	**Control Scheme:** Multi-objective congestion management examining optimal capabilities of dispersed generations	**Contribution:** To eliminate congestion at transmission lines of immensity power system.
[32]	**Control Scheme:** Distributed generation of integration as well as distributed static compensator	**Contribution:** To decrease search space as well as computational burden
[33]	**Control Scheme:** Optimal power flow solution in power systems	**Contribution:** To solve issue of optimal power flow (OPF)

[34]	**Control Scheme:** A market cleaning model for smart distribution systems.	**Contribution:** Developed to congestion management with support of FACTS devices at power system
[35]	**Control Scheme:** ESS optimal allocation as dispersed across allocation networks.	**Contribution:** Concurrently reduce voltage deviation, flickering, power loss, as well as line load
[36]	**Control Scheme:** Dynamic rate (DT) technique is designed to distribution system operator (DSO)	**Contribution:** To mitigate congestion that can occur at distribution network to great penetration of distributed energy resources (DER)
[37]	**Control Scheme:** Dynamic tariff method depend on distributed optimization to management of congestion at distribution network	**Contribution:** To reduce total cost of energy and line consumption loss cost
[38]	**Control Scheme:** Hierarchical as well as distributed congestion management idea to outlook allocation network	**Contribution:** Aims to operate network at reduction costs when maintaining satisfactory network condition
[39]	**Control Scheme:** Distributed allocation and planning distribution at deregulated electricity market.	**Contribution:** To better integrate flexible demand-side, demand-side management (DSM) to DGs
[40]	**Control Scheme:** Distributed solution at optimal DC power flow to congestion administration	**Contribution:** To increase social welfare, maintain the balance between supply and demand and alleviating congestion on the transmission line.
[41]	**Control Scheme:** Low voltage congestion management method Active distribution networks	**Contribution:** To solve congestion problem
[42]	**Control Scheme:** Dynamic Subsidy Technique to Congestion Management at Distribution Networks	**Contribution:** To resolve optimization via tightening restrictions as well as linearization.
[43]	**Control Scheme:** Distributed solution at optimal DC power flow to congestion Administration	**Contribution:** To increase social welfare, when maintaining balance between supply and demand and the relief of transmission line congestion.
[44]	**Control Scheme:** Static security restriction management, formulate SCOPF	**Contribution:** It can support design and activate optimal corrective actions.
[45]	**Control Scheme:** Significant problem of transmission network at deregulated power systems,	**Contribution:** To decrease construction cost and alleviate transmission network with TCSC / DG unit.
[46]	**Control Scheme:** Power system congestion management to Controller of Interline Power Flow	**Contribution:** For controlling congestion on transmission lines.
[47]	**Control Scheme:** Optimal power flow (OPF) methods depend on available transfer capacity	**Contribution:** To assign a TCSC employing congestion lease contribution
[48]	**Control Scheme:** Improvement of transfer capacity using FACTS devices	**Contribution:** Analysis of impact of FACTS control to improving the available transfer capacity (ATC).
[49]	**Control Scheme:** Placement of TCSC to congestion control at deregulated power system	**Contribution:** To manage congestion in an electric pool market.

8. Conclusion

Based on growing demand and trade in energy, transmission lines cannot be capable to transact energy with consumers. It causes congestion on system. To relieve congestion at short period of time, it is a demanding task on modern energy system. This article reviews the entire methods for managing congestion through dissimilar optimization systems used to alleviate congestion on system. The review primarily focuses on conventional congestion management processes. The required discussions are held at every topic. It is also stated that optimization tools play a significant role on relieving congestion. To fast growth of deregulated power markets, congestion management begins vital method to overcome congestion problems. Novel challenges as well as factors focus on employ of new methodologies to make well-organized technique that enhance the performance of power system at shortest possible time to alleviate congestion. A complete attempt was creating to display significance of congestion management technique in alleviating issue of congestion that emerging trend at many investigations. In this manuscript, researchers may expand the work and find faster and smarter solutions. The authors also suggest that the solution with congestion management issue can also be establish by considering variables such as load and water intake from random variables.

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Reference

[1] Pillay, A., Karthikeyan, S. P., & Kothari, D. P. (2015). Congestion management in power systems–A review. International Journal of Electrical Power & Energy Systems, 70, 83-90.

[2] Zaeim-Kohan, F., Razmi, H., & Doagou-Mojarrad, H. (2018). Multi-objective transmission congestion management considering demand response programs and generation rescheduling. Applied Soft Computing, 70, 169-181.

[3] Azmy, A. M. R., Barakatand, A., &Abaza, A. (2015). Improving Power System Performance Using Demand-Side Management Within Smart Grids Environment. Journal of Engineering Research, 1(2015), 223-233.

[4] Kumar, A., Srivastava, S. C., & Singh, S. N. (2005). Congestion management in competitive power market: A bibliographical survey. Electric Power Systems Research, 76(1-3), 153-164.

[5] Gunda, J., Harrison, G. P., &Djokic, S. Z. (2018). Remedial actions for security constraint management of overstressed power systems. IEEE transactions on power systems, 33(5), 5183-5193.

[6] Das, C. K., Bass, O., Kothapalli, G., Mahmoud, T. S., &Habibi, D. (2018). Optimal placement of distributed energy storage systems in distribution networks using artificial bee colony algorithm. Applied energy, 232, 212-228.

[7] Mythili, S., Thiyagarajah, K., Rajesh, P., & Shajin, F. H. (2020). Ideal position and size selection of unified power flow controllers (UPFCs) to upgrade the dynamic stability of systems: an antlion optimiser and invasive weed optimisation algorithm. HKIE Trans, *27*(1), 25-37.

[8] Peesapati, R., Yadav, V. K., & Kumar, N. (2018). Flower pollination algorithm based multi-objective congestion management considering optimal capacities of distributed generations. Energy, 147, 980-994.

[9] Rajesh, P., & Shajin, F., (2020). A Multi-Objective Hybrid Algorithm for Planning Electrical Distribution System. European Journal of Electrical Engineering 22(4-5), 224-509.

[10] Shajin, F. H., & Rajesh, P. (2020). Trusted secure geographic routing protocol: outsider attack detection in mobile ad hoc networks by adopting trusted secure geographic routing protocol. International Journal of Pervasive Computing and Communications.

[11] Thota, M. K., Shajin, F. H., & Rajesh, P. (2020). Survey on software defect prediction techniques. International Journal of Applied Science and Engineering, 17(4), 331-344.

[12] Reddy, S. S. (2016). Multi-objective based congestion management using generation rescheduling and load shedding. IEEE Transactions on Power Systems, 32(2), 852-863.

[13] Yuan, C., Hu C., & Li, T. (2019) Review of Congestion Management Methods for Power Systems, IOP Conference Series: Earth and Environmental Science, 233, 032025.

[14] Blanco, G., Waniek, D., Olsina, F., Garcés F., & Rehtanz, C. (2011) Flexible investment decisions in the European interconnected transmission system, Electric Power Systems Research, 81(4), 984-994.

[15] Agrawal, R., Bharadwaj S., & Kothari, D. (2018) Population based evolutionary optimization techniques for optimal allocation and sizing of Thyristor Controlled Series Capacitor, Journal of Electrical Systems and Information Technology, 5(3), 484-501.

[16] Esfahani, M. M., &Yousefi, G. R. (2016). Real time congestion management in power systems considering quasi-dynamic thermal rating and congestion clearing time. IEEE Transactions on Industrial Informatics, 12(2), 745-754.

[17] Gope, S., Goswami, A. K., Tiwari, P. K., & Deb, S. (2016). Rescheduling of real power for congestion management with integration of pumped storage hydro unit using firefly algorithm. International Journal of Electrical Power & Energy Systems, 83, 434-442.

[18] Karatekin, C. Z., &Ucak, C. (2008). Sensitivity analysis based on transmission line susceptances for congestion management. Electric Power Systems Research, 78(9), 1485-1493.

[19] Mende, D., Stock, D. S., Hennig, T., Löwer, L., & Hofmann, L. (2016, October). Multiobjective optimization in congestion management considering technical and economic aspects. In 2016 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC) (pp. 1061-1066). IEEE.
[20] Pati, B., &Karajgi, S. B. (2020). Optimized placement of multiple FACTS devices using PSO and CSA algorithms. International Journal of Electrical and Computer Engineering (IJECE), 10(4), 3350-3357.
[21] Bathina, V. R., &Gundavarapu, V. N. K. (2014). Optimal location of thyristor-controlled series capacitor to enhance power transfer capability using firefly algorithm. Electric Power components and systems, 42(14), 1541-1553.
[22] Mishra, A., &Gundavarapu, V. N. K. (2016). Line utilisation factor-based optimal allocation of IPFC and sizing using firefly algorithm for congestion management. IET Generation, Transmission & Distribution, 10(1), 115-122.
[23] Mandala, M., & Gupta, C. P. (2014). Optimal placement of TCSC for congestion management using modified particle swarm optimization. International Journal of Computer Applications, 88(11).
[24] Hooshmand, R. A., Morshed, M. J., & Parastegari, M. (2015). Congestion management by determining optimal location of series FACTS devices using hybrid bacterial foraging and Nelder–Mead algorithm. Applied Soft Computing, 28, 57-68.
[25] Bjørndal, E., Bjørndal, M., Midthun, K., &Zakeri, G. (2016). Congestion management in a stochastic dispatch model for electricity markets. NHH Dept. of Business and Management Science Discussion Paper (2016/12).
[26] Bavithra, K., Raja, S. C., &Venkatesh, P. (2016). Optimal setting of FACTS devices using particle swarm optimization for ATC enhancement in deregulated power system. IFAC-PapersOnLine, 49(1), 450-455.
[27] Khan, M. T., &Siddiqui, A. S. (2017). Congestion management in deregulated power system using FACTS device. International Journal of System Assurance Engineering and Management, 8(1), 1-7.
[28] Zaeim-Kohan, F., Razmi, H., & Doagou-Mojarrad, H. (2018). Multi-objective transmission congestion management considering demand response programs and generation rescheduling. Applied Soft Computing, 70, 169-181.
[29] Peesapati, R., Yadav, V. K., & Kumar, N. (2018). Flower pollination algorithm based multi-objective congestion management considering optimal capacities of distributed generations. Energy, 147, 980-994.
[30] Sannigrahi, S., Ghatak, S. R., Basu, D., &Acharjee, P. (2019). Optimal placement of DSTATCOM, DG and their performance analysis in deregulated power system. International Journal of Power and Energy Conversion, 10(1), 105-128.
[31] Attia, A. F., El Sehiemy, R. A., &Hasanien, H. M. (2018). Optimal power flow solution in power systems using a novel Sine-Cosine algorithm. International Journal of Electrical Power & Energy Systems, 99, 331-343.
[32] Bai, L., Wang, J., Wang, C., Chen, C., & Li, F. (2017). Distribution locational marginal pricing (DLMP) for congestion management and voltage support. IEEE Transactions on Power Systems, 33(4), 4061-4073.
[33] Das, C. K., Bass, O., Mahmoud, T. S., Kothapalli, G., Mousavi, N., Habibi, D., &Masoum, M. A. (2019). Optimal allocation of distributed energy storage systems to improve performance and power quality of distribution networks. Applied Energy, 252, 113468.
[34] Huang, S., & Wu, Q. (2019). Dynamic tariff-subsidy method for PV and V2G congestion management in distribution networks. IEEE Transactions on Smart Grid, 10(5), 5851-5860.
[35] Huang, S., Wu, Q., Zhao, H., & Li, C. (2017). Distributed optimization-based dynamic tariff for congestion management in distribution networks. IEEE Transactions on Smart Grid, 10(1), 184-192.
[36] Kulmala, A., Alonso, M., Repo, S., Amaris, H., Moreno, A., Mehmedalic, J., & Al-Jassim, Z. (2017). Hierarchical and distributed control concept for distribution network congestion management. IET Generation, Transmission & Distribution, 11(3), 665-675.
[37] Singh, A. K., &Parida, S. K. (2018). A review on distributed generation allocation and planning in deregulated electricity market. Renewable and Sustainable Energy Reviews, 82, 4132-4141.
[38] Xu, Y., Sun, H., Liu, H., & Fu, Q. (2018). Distributed solution to DC optimal power flow with congestion management. International Journal of Electrical Power & Energy Systems, 95, 73-82.
[39] Zhao, J., Wang, Y., Song, G., Li, P., Wang, C., & Wu, J. (2019). Congestion management method of low-voltage active distribution networks based on distribution locational marginal price. IEEE Access, 7, 32240-32255.
[40] Huang, S., & Wu, Q. (2019). Dynamic tariff-subsidy method for PV and V2G congestion management in distribution networks. IEEE Transactions on Smart Grid, 10(5), 5851-5860.
[41] Xu, Y., Sun, H., Liu, H., & Fu, Q. (2018). Distributed solution to DC optimal power flow with congestion management. International Journal of Electrical Power & Energy Systems, 95, 73-82.
[42] Gunda, J., Harrison, G. P., & Djokic, S. Z. (2018). Remedial actions for security constraint management of overstressed power systems. IEEE transactions on power systems, 33(5), 5183-5193.
[43] Ramesh, G., & Kumar, T. S. (2016). Optimal power flow-based congestion management in restructured power systems. International Journal of Power and Energy Conversion, 7(1), 84-96.
[44] Mishra, A., & Kumar, G. N. (2015). Congestion management of power system with interline power flow controller using disparity line utilization factor and multi-objective differential evolution. CSEE Journal of Power and Energy Systems, 1(3), 76-85.

[45] Sharma, A., & Jain, S. K. (2019). Gravitational search assisted algorithm for TCSC placement for congestion control in deregulated power system. Electric Power Systems Research, 174, 105874.
[46] Xiao, Y., Song, Y. H., Liu, C. C., & Sun, Y. Z. (2003). Available transfer capability enhancement using FACTS devices. IEEE transactions on power systems, 18(1), 305-312.
[47] Sharma, A., & Jain, S. K. (2019). Gravitational search assisted algorithm for TCSC placement for congestion control in deregulated power system. Electric Power Systems Research, 174, 105874.
[48] Shen, F., Huang, S., Wu, Q., Repo, S., Xu, Y., & Østergaard, J. (2018). Comprehensive Congestion Management for Distribution Networks Based on Dynamic Tariff, Reconfiguration, and Re-Profiling Product. IEEE Transactions on Smart Grid, 10(5), 4795-4805.
[49] Hosseini, S. A., Amjady, N., Shafie-khah, M., &Catalao, J. P. (2016). A new multi-objective solution approach to solve transmission congestion management problem of energy markets. Applied Energy, 165, 462-471.
[50] Mariolis, T. (2018). A Sraffian (no) trade-off between autonomous demand and transfer payments. Metroeconomica, 69(2), 473-487.
[51] Verma, S., & Mukherjee, V. (2016). Firefly algorithm for congestion management in deregulated environment. Engineering Science and Technology, an International Journal, 19(3), 1254-1265.
[52] Wang, Y., Wang, S., &Xu, W. J. (2010). Unified Framework and Performance Analysis of Transaction Adjustment Models in Congestion Management of Power System. In Applied Mechanics and Materials (Vol. 37, pp. 1615-1618). Trans Tech Publications Ltd.
[53] Ahmed, F., &Hawas, Y. E. (2015). An integrated real-time traffic signal system for transit signal priority, incident detection and congestion management. Transportation Research Part C: Emerging Technologies, 60, 52-76.
[54] Dehnavi, E., &Abdi, H. (2016). Determining optimal buses for implementing demand response as an effective congestion management method. IEEE Transactions on Power Systems, 32(2), 1537-1544.
[55] Haque, A. N. M. M., Nguyen, P. H., Bliek, F. W., & Slootweg, J. G. (2017). Demand response for real-time congestion management incorporating dynamic thermal overloading cost. Sustainable Energy, Grids and Networks, 10, 65-74.
[56] Salehizadeh, M. R., Rahimi-Kian, A., &Oloomi-Buygi, M. (2015). Security-based multi-objective congestion management for emission reduction in power system. International Journal of Electrical Power & Energy Systems, 65, 124-135.
[57] Yousefi, A., Nguyen, T. T., Zareipour, H., & Malik, O. P. (2012). Congestion management using demand response and FACTS devices. International Journal of Electrical Power & Energy Systems, 37(1), 78-85.
[58] Dehnavi, E., &Abdi, H. (2016). Determining optimal buses for implementing demand response as an effective congestion management method. IEEE Transactions on Power Systems, 32(2), 1537-1544.
[59] He, X., & Wang, W. (2014). Fuzzy multi objective optimal power flow based on modified artificial BEE colony algorithm. Mathematical Problems in Engineering, 2014.
[60] Behera, S. K., &Mohanty, N. K. (2019). Congestion management using thyristor controlled series compensator employing Improved Grey Wolf Optimization technique. The International Journal of Electrical Engineering & Education, 0020720918822730.
[61] Salkuti, S. R., & Kim, S. C. (2019). Congestion management using multi-objective glowworm swarm optimization algorithm. Journal of Electrical Engineering & Technology, 14(4), 1565-1575.
[62] Chintam, J. R., & Daniel, M. (2018). Real-power rescheduling of generators for congestion management using a novel satin bowerbird optimization algorithm. Energies, 11(1), 183.
[63] Verma, S., & Mukherjee, V. (2016). Optimal real power rescheduling of generators for congestion management using a novel ant lion optimizer. IET Generation, Transmission & Distribution, 10(10), 2548-2561.
[64] Boonyaritdachochai, P., Boonchuay, C., & Ongsakul, W. (2010, June). Optimal congestion management in electricity market using particle swarm optimization with time varying acceleration coefficients. In AIP Conference Proceedings (Vol. 1239, No. 1, pp. 382-387). American Institute of Physics.
[65] Batra, I., &Ghosh, S. (2019). A Novel Approach of Congestion Management in Deregulated Power System Using an Advanced and Intelligently Trained Twin Extremity Chaotic Map Adaptive Particle Swarm Optimization Algorithm. Arabian Journal for Science and Engineering, 44(8), 6861-6886.