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Simulation and Analysis for Mitigating Voltage Sags and Swells

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***Abstract*—This paper presents the modeling and simulation for mitigation of voltage sags and swells which are the major problems and issues on nonlinear loads. Voltage sag problem is the most frequently occurring and detrimental power quality problems. Thus, the purpose of this study was to assuage voltage sag problem using proposed Distribution Static Compensator (DSTATCOM).The performance of a DSTATCOM in mitigating voltage sag/ swell is demonstrated with the help of MATLAB. The modeling and simulation results of a DSTATCOM are presented. D-STATCOM is promising device Which is used for voltage sag, swell mitigation at distribution side. The proposed D-STATCOM is modeled and simulated using MATLAB/SIMULINK software. The simulation results show clearly the performance of a DSTATCOM in mitigating voltage sags and swells and also it has a fast dynamic response.**

***Index Terms*— Distribution Static Compensator (DSTATCOM), Voltage Sag, voltage swell, MATLAB/SIMULINK.**

I. INTRODUCTION

Power Quality problems encompass a wide range of disturbances such as voltage sags/swells, flicker, harmonics distortion, impulse transient, and interruptions [1]. Voltage sags can occur at any instant of time, with amplitudes ranging from 10 – 90% and a duration lasting for half a cycle to one minute [2]. Voltage swell, on the other hand, s defined as a swell s defined as an increase n rms voltage or current at the power frequency for durations from 0.5 cycles to 1 min. typical magnitudes are between 1.1 and 1.8 up. Swell magnitude s also s also described by its remaining voltage, n this case, always greater than 1.0. [3]. Voltage swells are not as important as voltage sags because they are less common in distribution systems. Voltage sag and swell can cause sensitive equipment (such as found n semiconductor or chemical plants) to fail, or shutdown, as well as create a large current unbalance that could blow fuses or trip breakers. These effects can be very expensive for the customer, ranging from minor quality variations to production downtime and equipment damage [4]. There are many different methods to mitigate voltage sags and swells, but the use of a custom Power device s considered to be the most efficient method. Switching off a large inductive load or Energizing a large capacitor bank s a typical system event that causes swells [5].This paper introduces Dynamic Voltage Restorer and its operating principle. Then, a simple control based on dqo method s used to

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compensate voltage sags/swell. At the end, MATLAB/SIMULINK model based simulated results were presented to validate the effectiveness of the proposed control method of DVR.

II. D-STATCOM

A distribution static compensator (DSTATCOM) s the most efficient and effective modern custom power device used in power distribution system. Its appeal includes lower cost, smaller size, and its fast dynamic response to the disturbance. D-STATCOM consists of a voltage source converter (VSC), a DC energy storage device (ESD), a coupling transformer connected n shunt to the distribution system through a coupling transformer. The VSC converts the DC voltage across the storage device into a set of three phase AC output voltages. These voltages are in phase and coupled with the AC system through the reluctance of the coupling transformer. Suitable adjustment of the phase and magnitude of the DSTATCOM output voltages allows effective control of active and reactive power exchanges between the D-STATCOM and the AC system. Such configuration allows the device to absorb or generate controllable active and reactive power.

III. SIMULATION MODEL FOR THE SYSTEM

To enhance the performance of distribution system, D-STATCOM was connected to the distribution system. The performance of the distribution system in terms of power quality problems s analysed by connecting the D-STATCOM. Distribution STATCOM was designed using MATLAB simulink software. The simulink model for the proposed system is as shown n fig 3. Comprises a 230kV, 50Hz transmission system, represented by a Thevenin equivalent, feeding nto the primary side of a 3-winding transformer connected n Y/Y/Y, 230/11/11 kV. A varying load s connected to the 11 kV, secondary side of the transformer. A two-level D-STATCOM is connected to the 11 kV tertiary winding to provide instantaneous voltage support at the load point. A 75 μF capacitor on the dc side provides the DSTATCOM energy storage capabilities. Circuit Breaker s used to control the period of operation of the D-STATCOM.

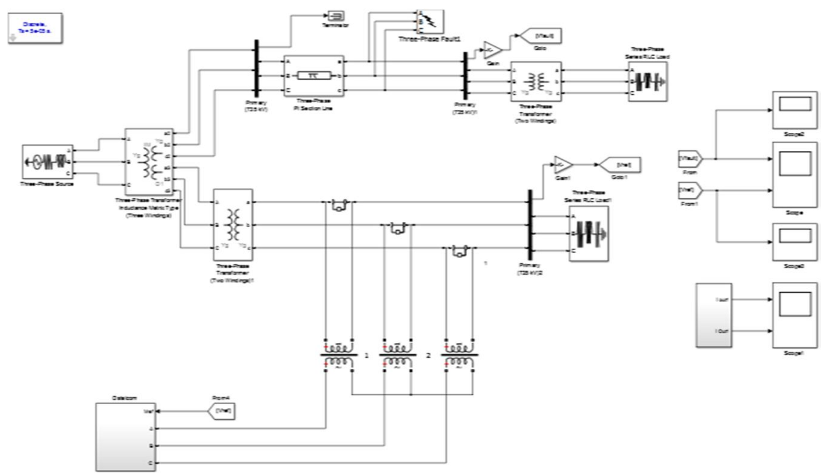

Figure 1.Simulation diagram with DSTATCOM

IV. D-STATCOM SIMULATIONS AND RESULTS FOR VOLTAGE SAG

The simulation results without D-STATCOM and for a three-phase short-circuit fault is applied at load point with a fault resistance of 0.2, during the period 300-600 ms. The voltage sag at the load point s 36% with respect to the reference voltage.

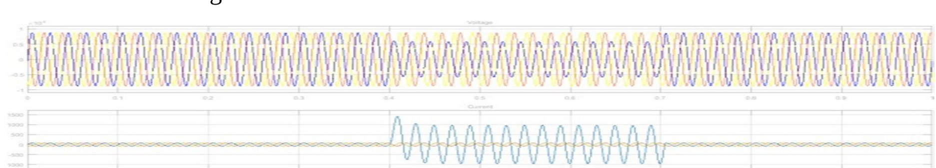

Figure 2. Simulation result for single phase fault

Simulation result for load (2 phase balanced load) in this system balanced voltage sag and current swell are occur for a duration 400ms to 700ms.

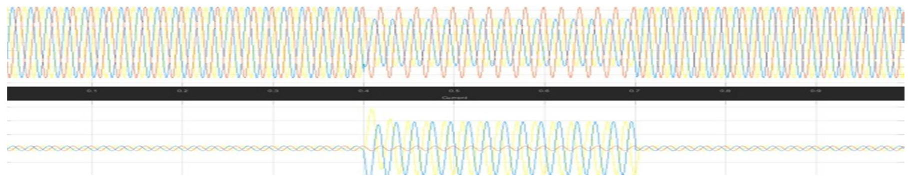

Figure 3. Simulation result for two phase fault

Simulation result for load (3 phase balanced load) in this system balanced voltage sag and current swell are occur for a duration 400ms to 700ms.

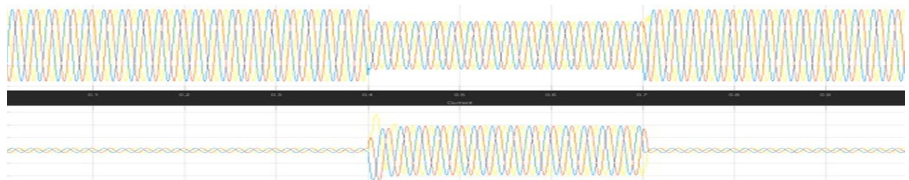

Figure 4. Simulation result for three phase fault

V. Grey Wolf Optimization Applied to Single Phase and Three Phase Problems

In this work, an efficient and comparatively new algorithm named GWO is proposed to solve the ELD problem taking the valve point loading effects, multiple fuel, prohibited operating zone, ramp rate limits into consideration. The benefit of the proposed GWO s that t does not impose any convexity limitations on the generating unit characteristics. Numerical results show that the GWO method has superior features, advantages over other algorithms n terms of robustness, less computational efforts, avoids premature convergence, simple applicability and stable convergence characteristic. Although, the proposed algorithm is applied to solving problems in the current study, it seems from its unique feature that GWO has the potential to solve many other optimization problems in the field of power system planning and operation.The GWO is stopped executing when the maximum number of iterations (generations) is reached or there is no noteworthy improvement n the solution. n this paper, the ending criterion s the maximum number of iterations for which most of the grey wolves or search agents are idle.

VI. Final Model after Grey Wolf Optimization

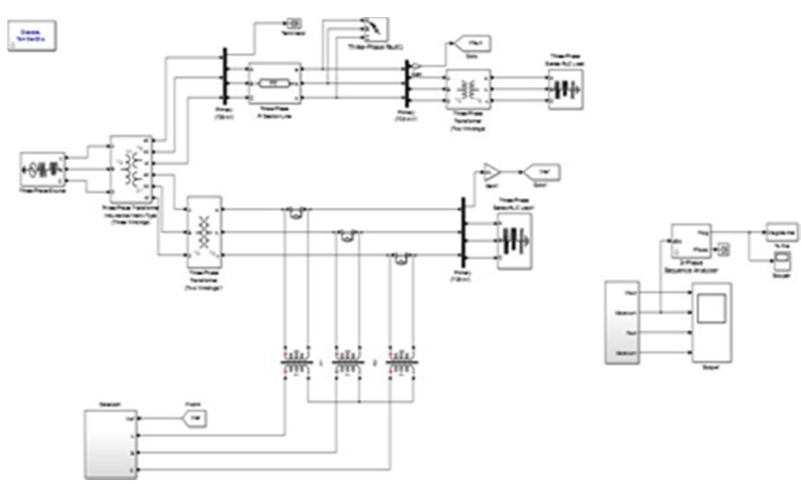

Figure 5. Model for GWO

VII. SIMULATION RESULT OF FINAL MODEL

Simulation result of final model after grey wolf optimization

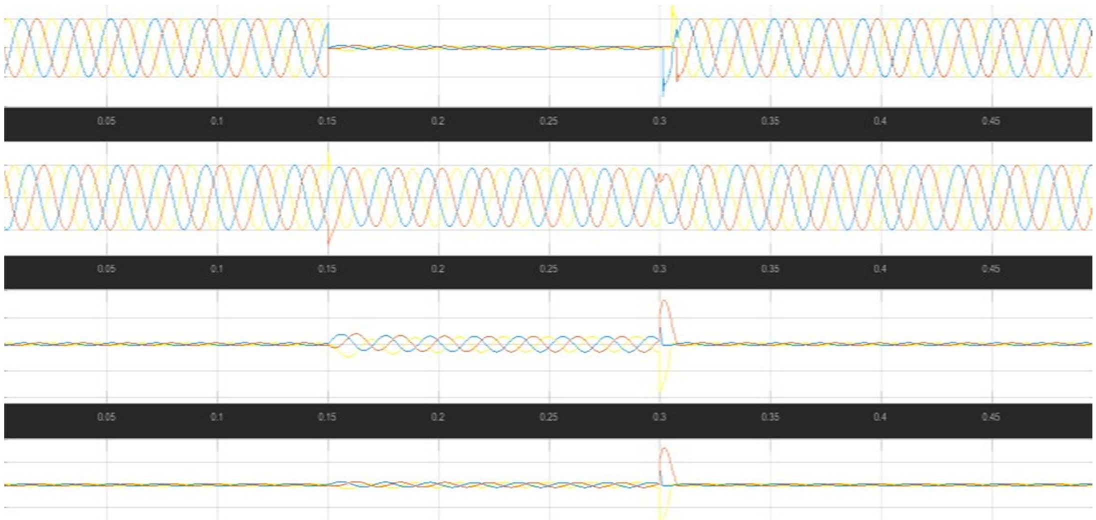

Figure 6. Simulation result for GWO

VIII. CONCLUSIONS

The performance of a DSTATCOM in mitigating voltage sag/ Cureent swell is demonstrated with the help of MATLAB. The modeling and simulation results of a DSTATCOM are presented. D-STATCOM is promising device which is used for voltage sag, cureent swell mitigation at distribution side..DSTATCOM compensator is a flexible device.which can operate in current control mode for compensating voltage variation, unbalance and reactive power and in voltage control mode as a voltage stabilizer. In this work, an efficient and comparatively new algorithm named GWO is proposed to solve the problem taking the valve point loading effects, multiple fuel, prohibited operating zone, ramp rate limits into consideration. The benefit of the proposed GWO is that it does not impose any convexity limitations on the generating unit characteristics.Simulation results show that the GWO method has superior features, advantages over other algorithms in terms of robustness, less computational efforts, avoids premature convergence, simple applicability and stable convergence characteristic. Although, the proposed algorithm is applied to solve problems in the current study, it seems from its unique feature that GWO has the potential to solve many other optimization problems in the field of power system planning and operation.

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