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Atom Search Optimization for Power Quality Enhancement in Grid-Connected PV, Wind, and Battery Systems

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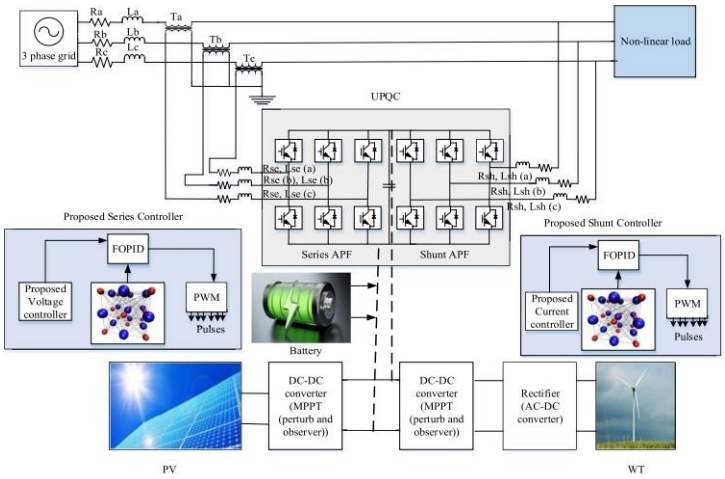
Abstract

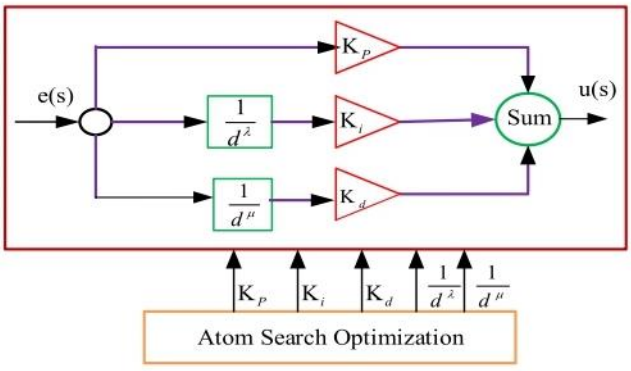
Many different methods to mitigate the PQ problems with integrated FACT devices by researchers. Some of the works related to PQ problem mitigation are reviewed in thissection.

System model descrip-tion of the proposed method



FOPID CONTROLLER

The proposed FOPID with ASO algorithm is used to com- pensate power quality issues of voltage and current distur- bances in HRES system [1]. The different controllers are avail-able to tune the parameters such as proportional integral (PI), Proportional Integral Derivative (PID) controller and so on[2]. Compared to conventional controllers of PI and PID, the FOPID controller provides the best freedom of degree because it has five parameters which provide the best resultsin the controller part[3]. The error voltage and error currents values are reduced by providing optimal pulses to FOPID controller [4].



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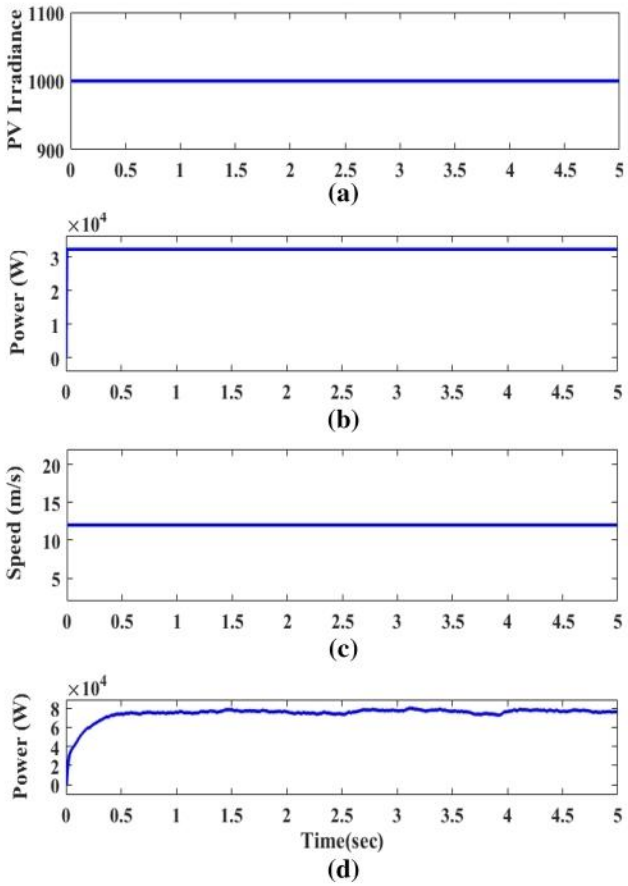
ATOM SEARCH ALGORITHM

The ASO is designed related to basic molecular dynamics [5]. Related on synthetic and physical structure, the particles aremade and it is the littlest unit of a substance compound [6]. Theparticles have comparable substance properties and it madeout of iotas by covalent bonds which shift enormously regarding size and multifaceted nature[7].

Performance Evaluation

Case 1: Voltage and current sag condition (constantsource). Analysis of HRES system performance **a** PV irradiance, **b** PV power, **c** wind speed, **d** Wind power



Case 2: Voltage and current swell condition (variedsource).

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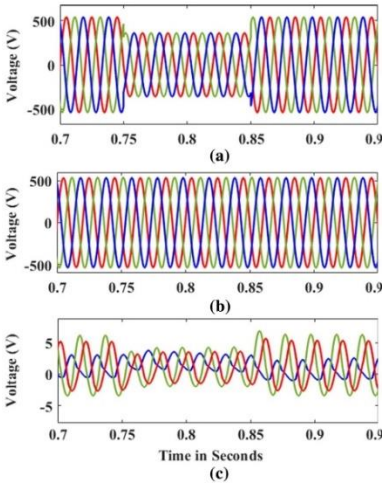
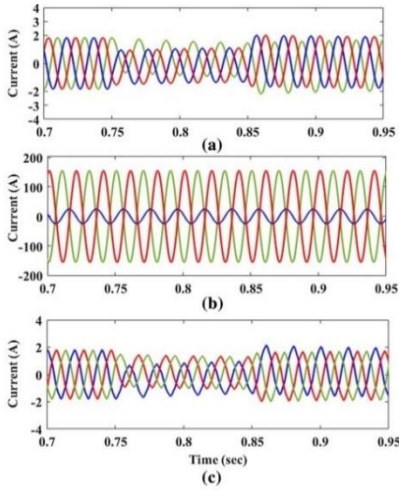
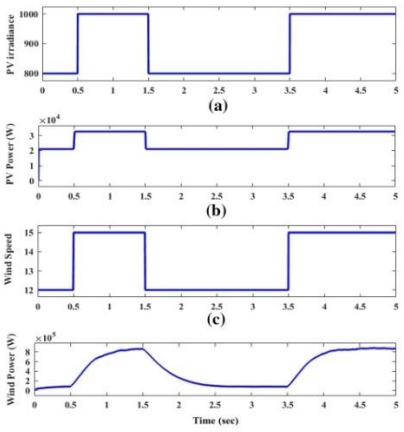


Analysis of current sag condition a.source current b load current c .injected current



Analysis of HRES performance **a** PV irradiance, **b** PV power,**c** wind speed, **d** wind power



ISSN PRINT 2319 1775 Online 2320 7876

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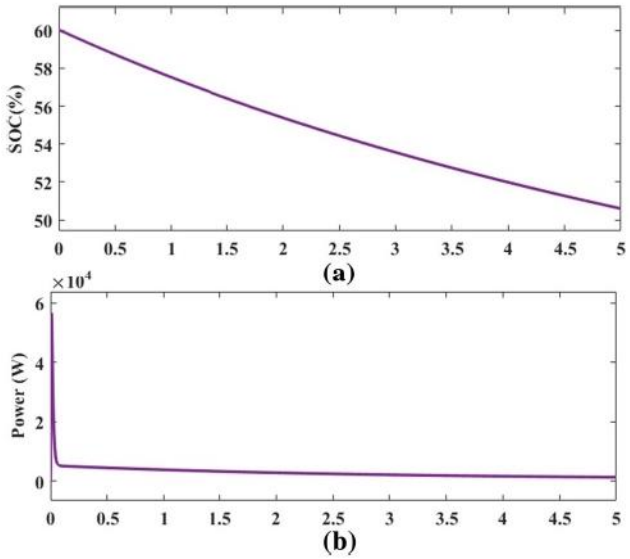
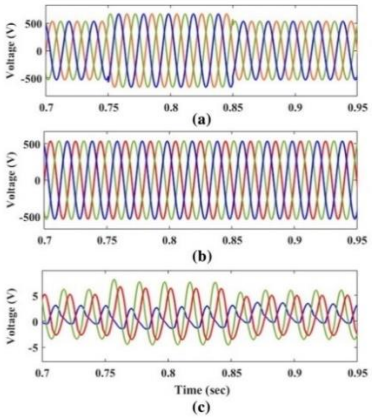
The series and shunt activepower filter with FOPID controller-based ASO is mainly participated to find out the error values which correct by selecting optimal parameters of the system [8]. The voltage dis-turbance conditions are analysed in the below section [9].

ANALYSIS OF BATTERY PERFORMANCE



Analysis of voltage swell conditions **a** source voltage, **b** loadvoltage, **c** injected voltage



Analysis of current swell conditions **a** source current, **b** load

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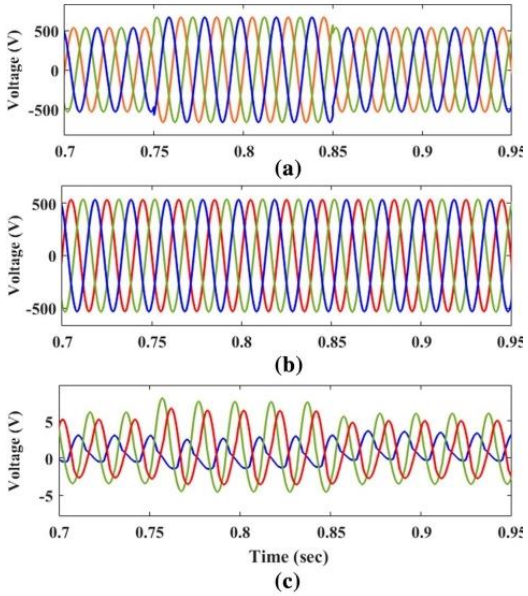
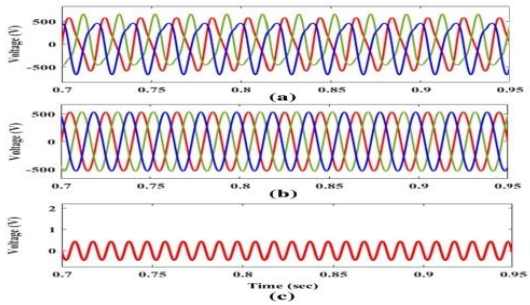


Case 3: Voltage and current disturbances (constant source).Analysis of voltage disturbance conditions **a** source voltage,
b load voltage, **c** injected voltage



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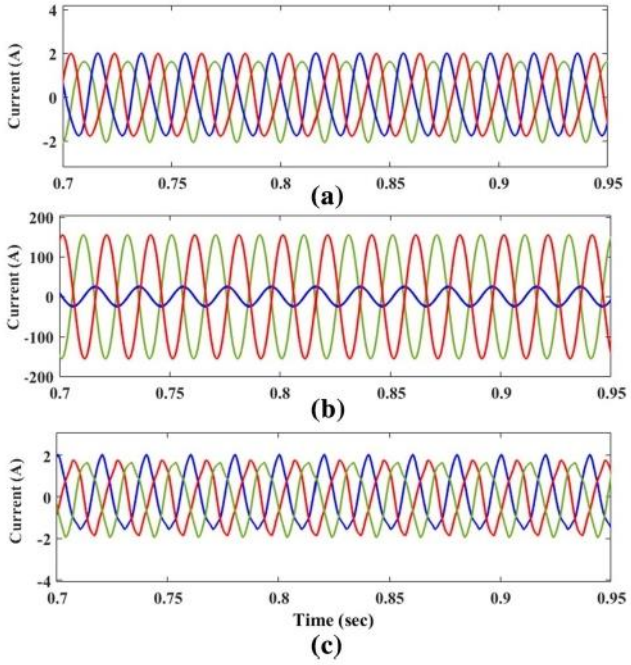
ANALYSIS OF CURRENT–VOLTAGE DISTURBANCE CONDITIONS A SOURCE CURRENT, B LOAD CURRENT, C INJECTED CURRENT



COMPARISON ANALYSIS

A COMPARISON OF REAL POWER. B COMPARISON ANALYSIS OF REACTIVE POWER

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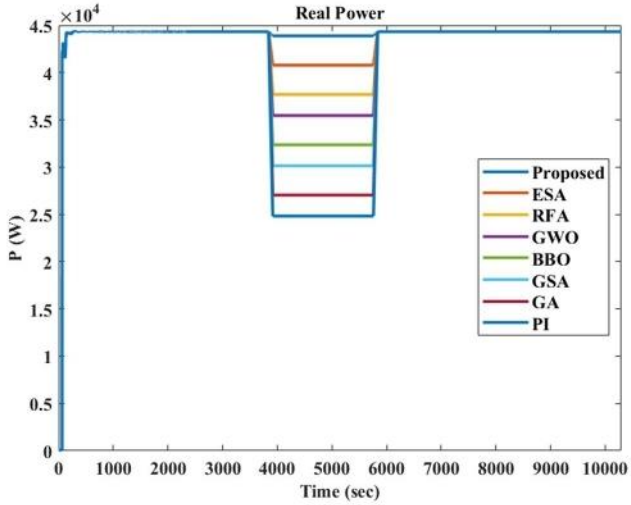
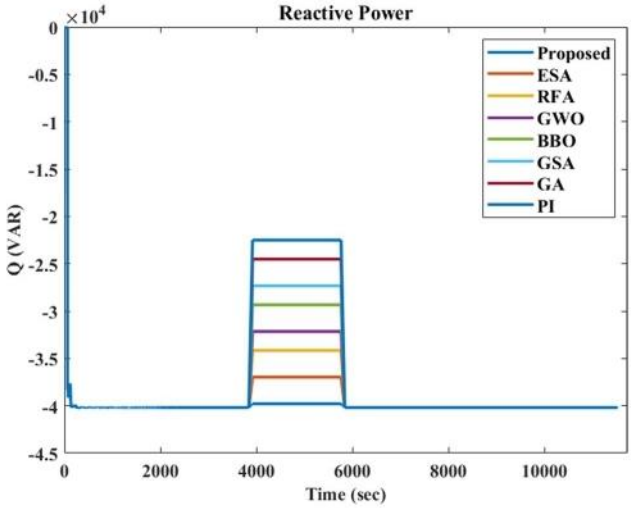


(a)

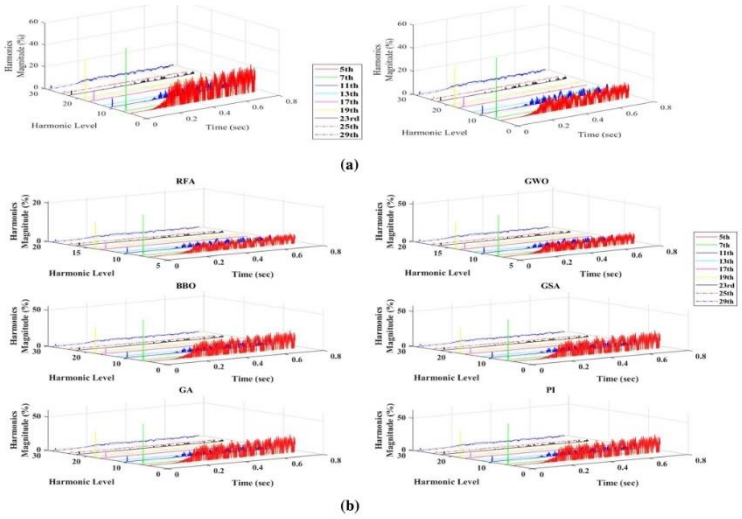


(b)

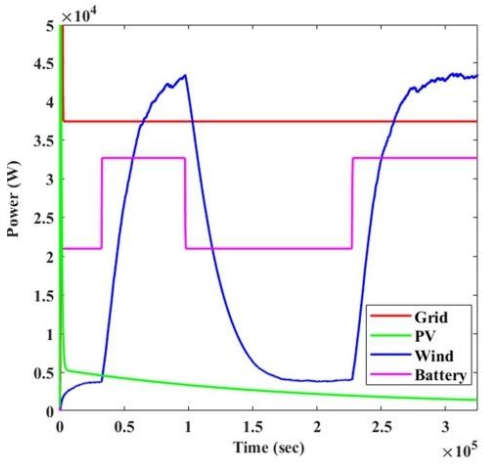
ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021

DISCUSSION



Comparison analysis of grid power with the generation



CONCLUSION

So, FACT devices are integrated into the system to mitigate

the power quality issues. In the proposed HRES the UPQC with a proper controller is designed to solve power quality issues and compensate load demand. The proposed HRES system is designed with PV, WT and BESS system. The BESS system is used to compensate load demand under environmental conditions. The UPQC is designed with two controllers in series active power filter and shunt active power filter by incorporating FOPID controller with ASO for parameter tuning. The power quality issues in terms of voltage and current are mitigated using the proposed UPQC system. The proposed method is modelled and implemented in MATLAB/Simulink. Then the model is validated using three different cases by connecting non-linear load in the grid side. The results of the system are evaluated using voltage sag, swell, disturbance and harmonics. Ultimately proposed method is compared with

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existing techniques like PI controller, GSA, GWO, BBO, ESA, RFA and GA opti-misation-based controllers

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