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An intelligent method for grid-connected HRES systems to reinforce power quality at its best EVORFA Approach

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Abstract

The suggested hybrid strategy, also known as the EVORFA technique, combines the random forest algorithm (RFA) and Egyptian vulture optimization algorithm (EVOA).

Voltage stabilization, power loss reduction, and exacerbating harmonic distortion are the main goals of this res earch.

Load current, DClink voltage, and voltage sources are based on reduced error objective function; EVOA is pri marily used to differentiate the ideal combination offline and produces the dataset of proportional integral gain parameters.Multiple parameters that are related to power quality (PQ) concerns are taken into consideration b y EVOA. The RFA forecasts the best possible control.

Introduction

Nowadays, converter-based HRES management has been focused on active with reactive power generation [1] stand- alone modes [2] grid-connected modes [3]boost power quality, reliability, and power grid stability[4] Owing to the advancement of renewable energy technologies and the rising cost of petroleum products[5]

Various investigation works are existed in bibliography based on PQ reinforcement in grid-connected HRES system using different strategies [6]. Some of them are assessed here.

This article suggests an intelligent strategy for grid-connected hybrid renewable energy sources [7] like solar photovoltaic, wind turbines, and battery storage to improve power quality [8]. The suggested hybrid Based on the completed dataset, the RFA predicts the most optimal control signal with the least amount of error [9]. The MATLAB/Simulink work site is used to implement the suggested EVORFA method [10]. The EVORFA technique performs in two modes, namely PQ reinforcement (PRES = 0) and simultaneous PQ reinforcement and RES power injection (PRES > 0) [11]. The experimental findings are then contrasted with those of already-in-use techniques like gravitational search algorithms (GSA) and RFA [12].

CONFIGURATION OF PROPOSED SYSTEM

illustrates the configuration of proposed system. Back-back interface power electronic converters over at ordi- nary DC-link, for example, generator side converter with grid side converter associated[13]. Straightly DC interface, the sin-gle stage solar PV (SPV) matrix is associated. Because of reverse current flow, diode blocking is associated with a series of SPV matrix [14]. By using the EVORFA strategy, the GeSC and GrSC are controlled. In common point of interconnection, the three phase nonlinear load has been associated with ripple filters, which assimilate switching harmonics [15]. To

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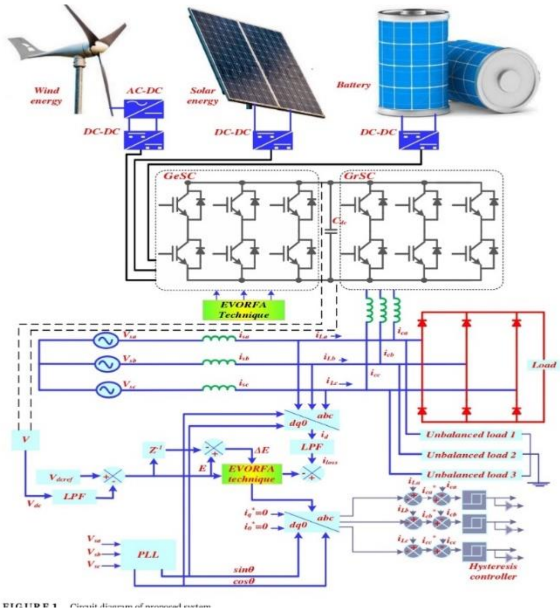
diminish the current harmonics, the inductor interfacing is associated in series to grid.

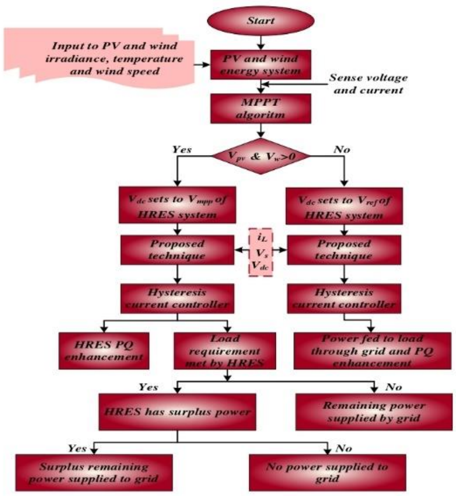
Circuit diagram of proposed system



Major objectives including contributions of these manuscripts are:

- Photovoltaic-wind design of based on HRES.
- Incorporation of EVORFA technique in HRES system with enhance power quality.
- Maximum power removal in photovoltaic-wind system using EVORFA technique.
- Voltage stabilize.
- Power loss reduction.
- Extenuating harmonic distortion.

Proposed system design



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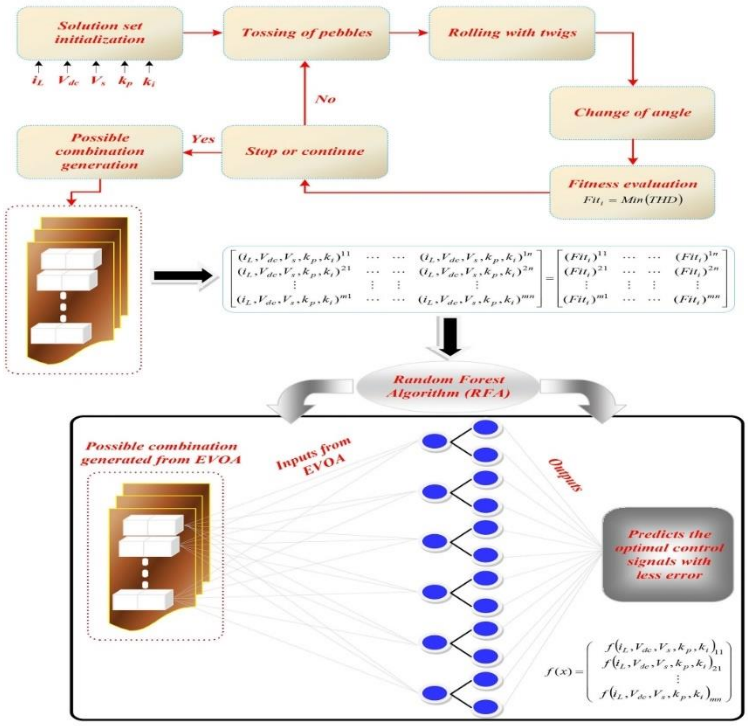
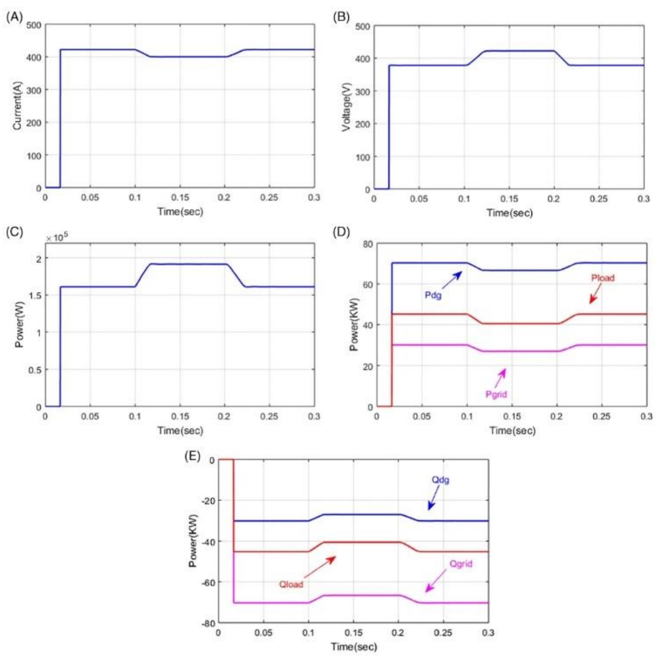
SIMULATION RESULTS AND DISCUSSION OF OPQR IN A GRID-CONNECTED HRES SYSTEM

Process of EVORFA method



SIMULTANEOUS PQ REINFORCEMENT AND RES POWER INJECTION, $P_{RES} > 0$

Performance of, A, RES current; B, RES voltage; C, RES power; D, active power; E, reactive power



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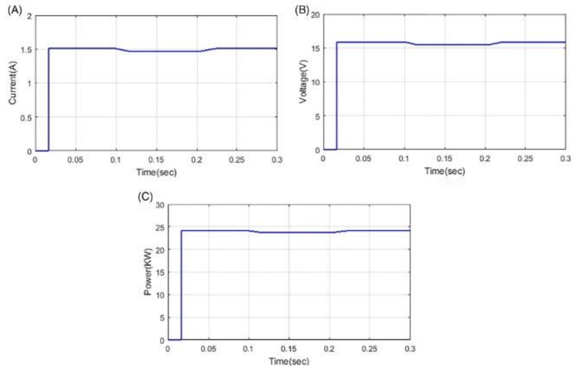
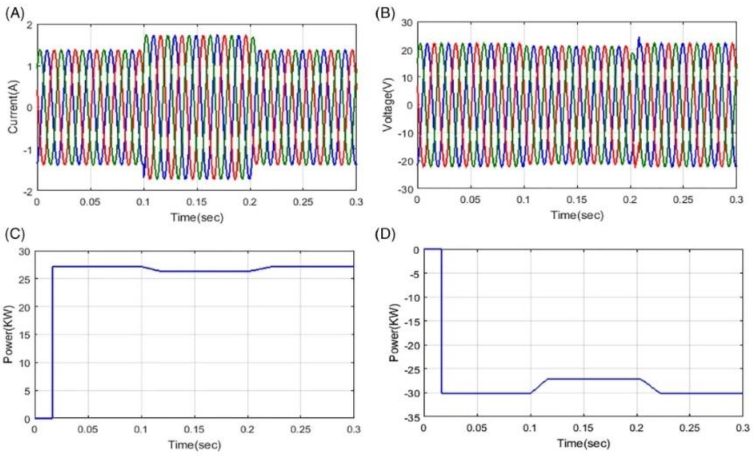
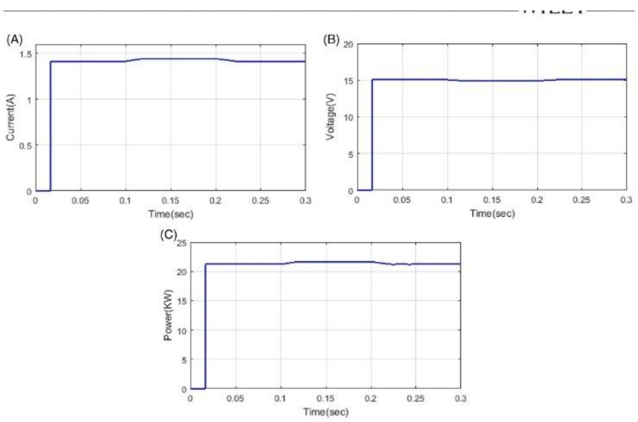
Photovoltaic performance, A, current; B, voltage; C, power



Performance of wind, A, current; B, voltage; C, active power; D, reactive power



Performance of battery, A, current; B, voltage; C, power



Grid performance, A, active power; B, reactive power

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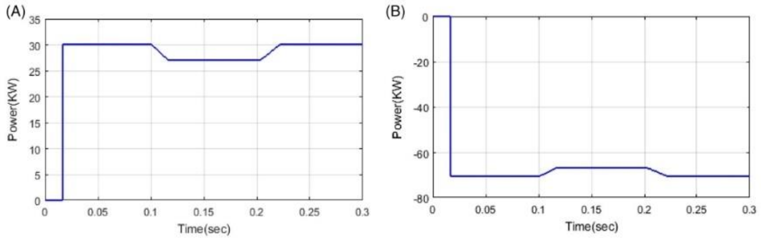
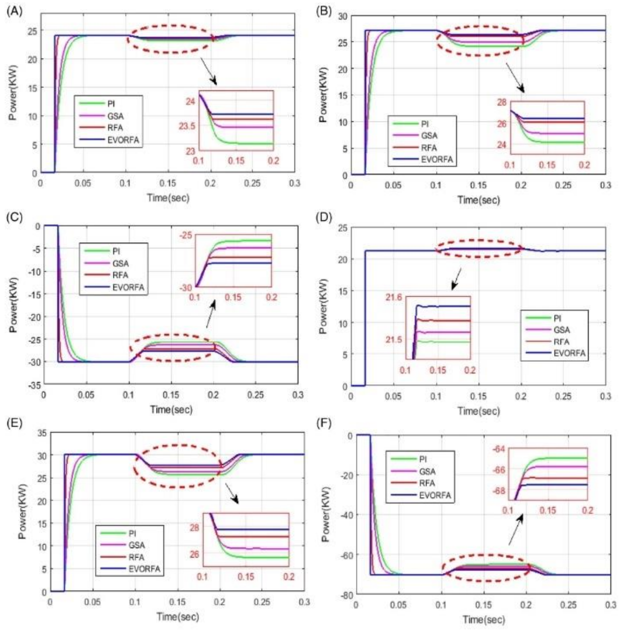
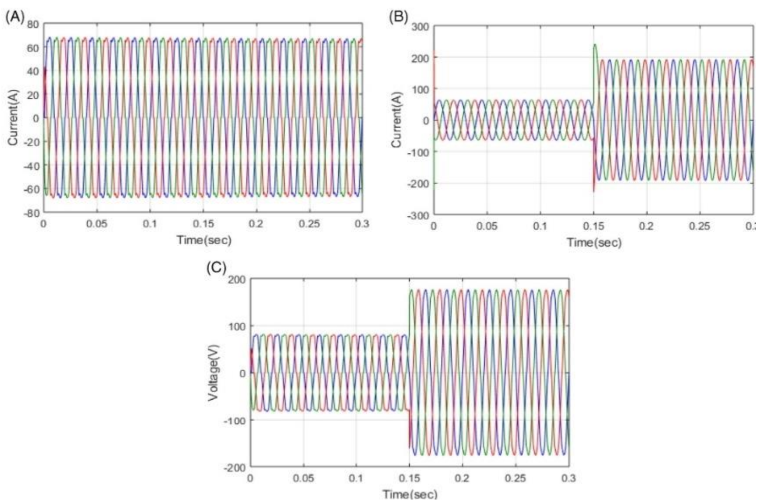


Power comparison graph of, A, photovoltaic; B, wind active power; C, wind reactive power; D, battery power; E, grid active power; F, grid reactive power



Performance of, A, load current; B, inverter terminal output current; C, PCC voltage in startup



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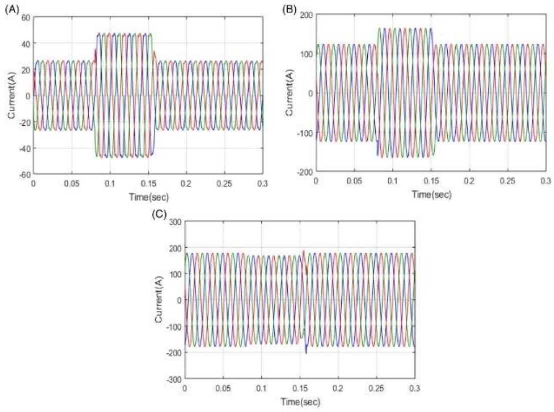
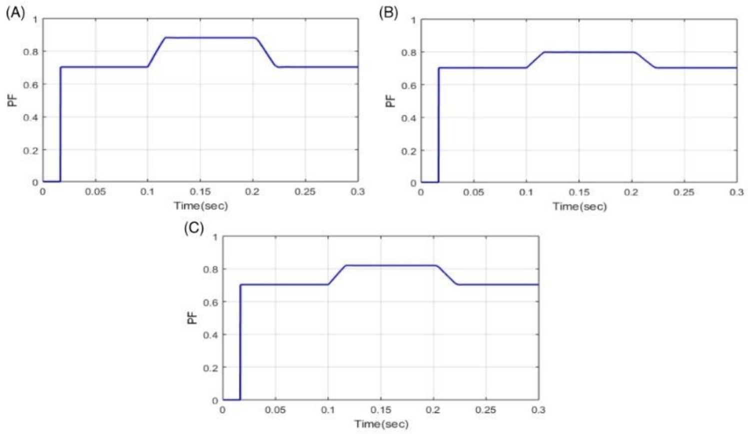
PQ REINFORCEMENT (P_{RES} = 0)

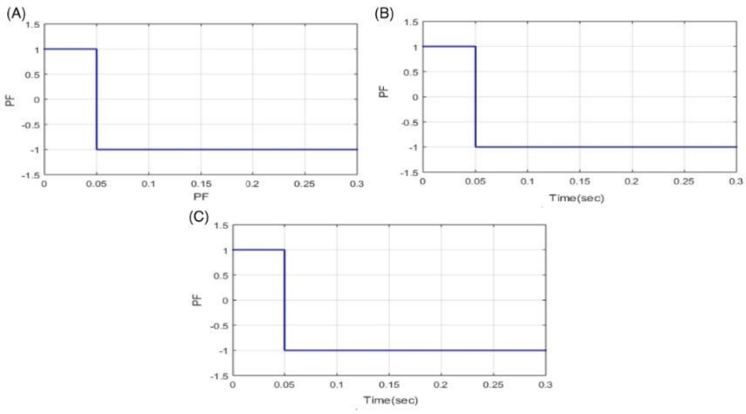
Performance of, A, load current; B, inverter terminal output current; C, grid current in nonlinear load variation



Performance of source power factor Phase A, B, C in unbalanced nonlinear load variation



Performance of load power factor Phase A, B, C in unbalanced nonlinear load variation



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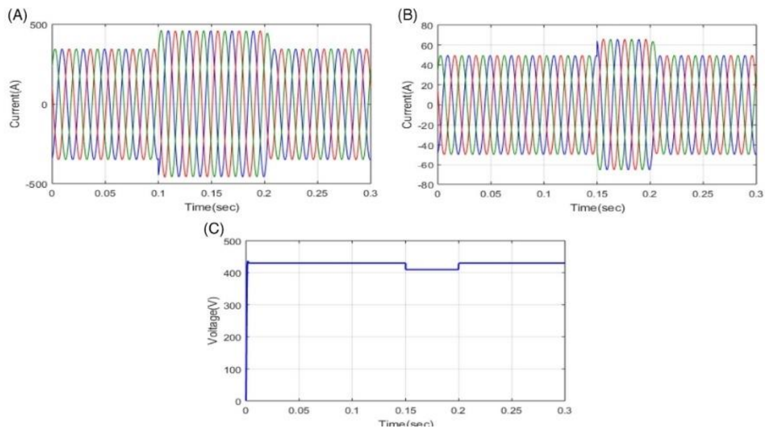
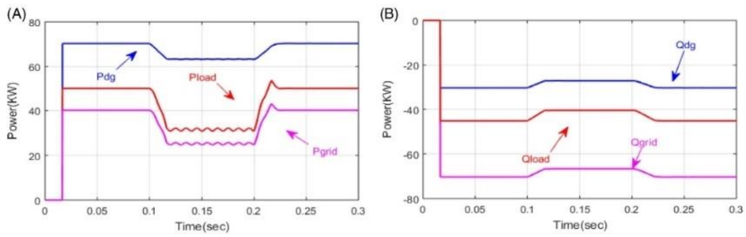
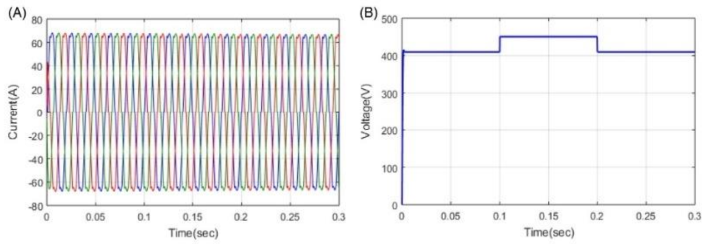
Performance of, A, inverter terminal current; B, grid current; C, DC-link voltage in unbalanced nonlinear load variation



Performance of, A, active power; B, reactive power



Performance of, A, load current; B, DC-link voltage in startup



Performance of, A, load current; B, inverter terminal output current; C, grid current; D, inverter terminal outputvoltage; E, DC-link voltage in nonlinear load variation

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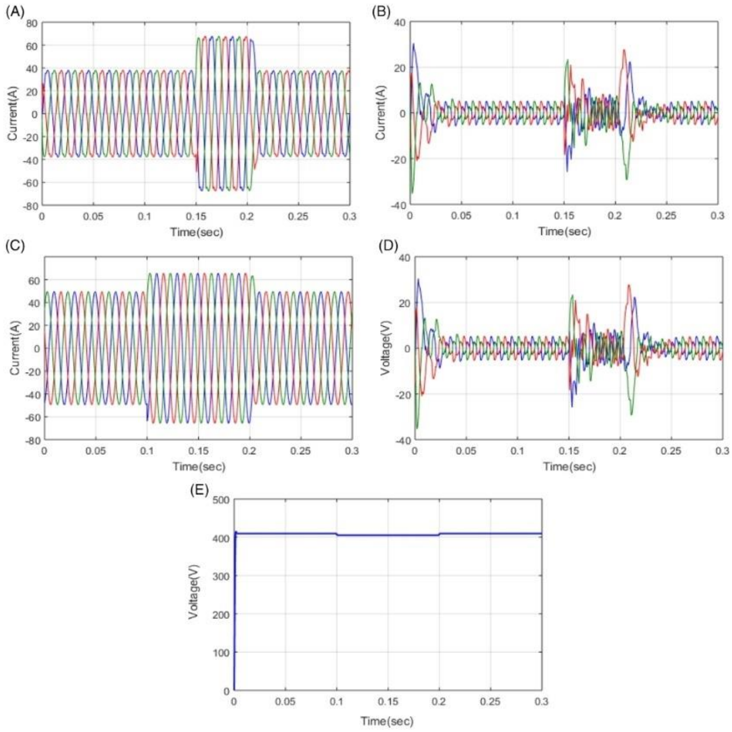

Performance of source power factor, A, Phase A; B, Phase B; C, Phase C in unbalanced nonlinear load variation

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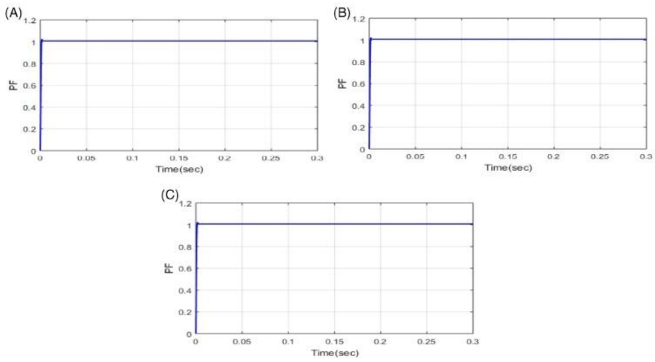

FIGURE 18 Performance of source power factor, A, Phase A; B, Phase B; C, Phase C in unbalanced nonlinear load variation

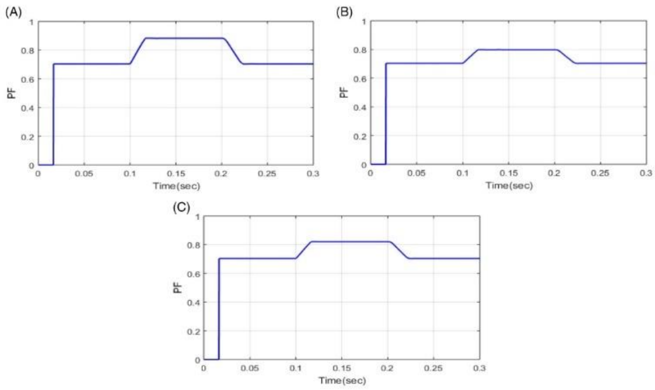

FIGURE 19 Performance of load power factor, A, Phase A; B, Phase B; C, Phase C in unbalanced nonlinear load variation

Performance of load power factor, A, Phase A; B, Phase B; C, Phase C in unbalanced nonlinear load variation

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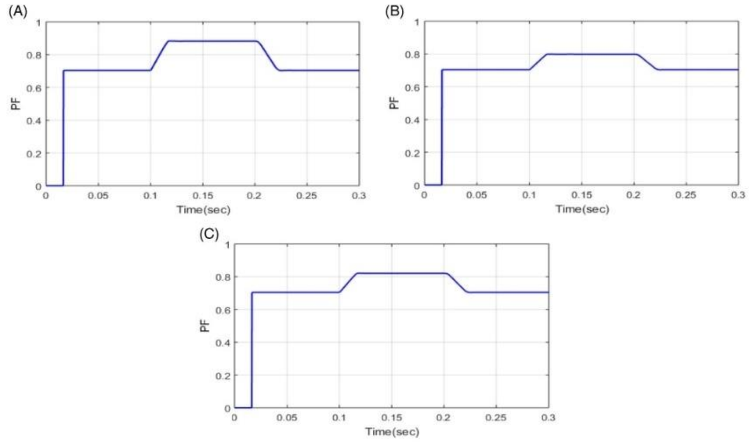
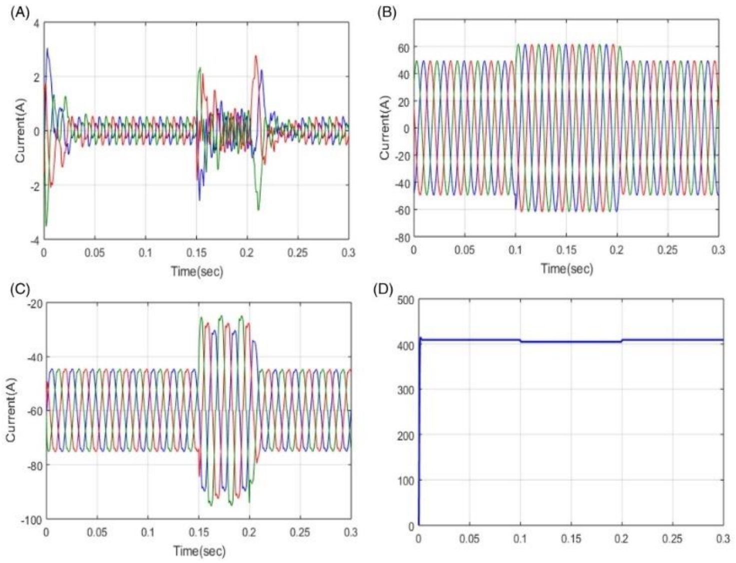
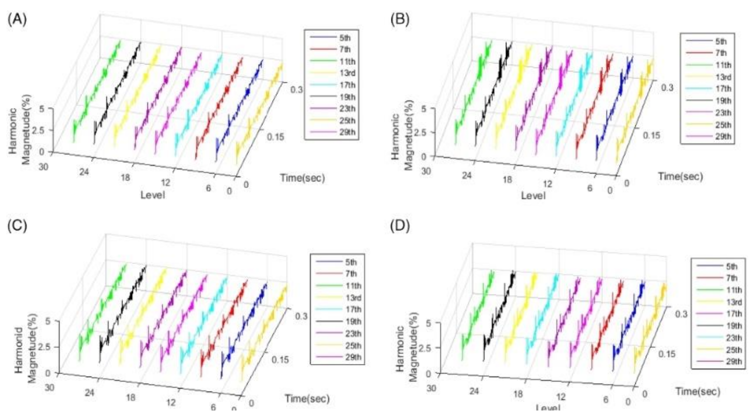


Performance of, A, inverter terminal current; B, grid current; C, load current; D, DC-link voltage in unbalanced nonlinearload variation



THD comparison of, A, PI; B, GSA; C, RFA; D, proposed technique



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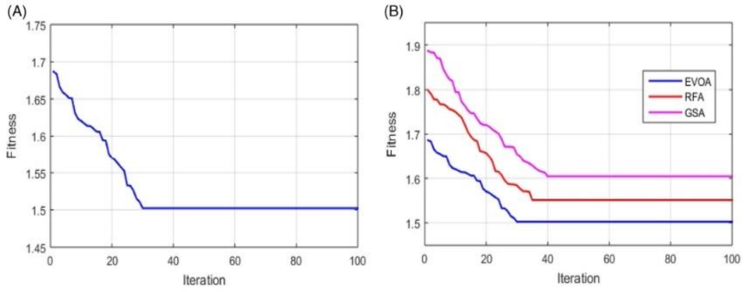
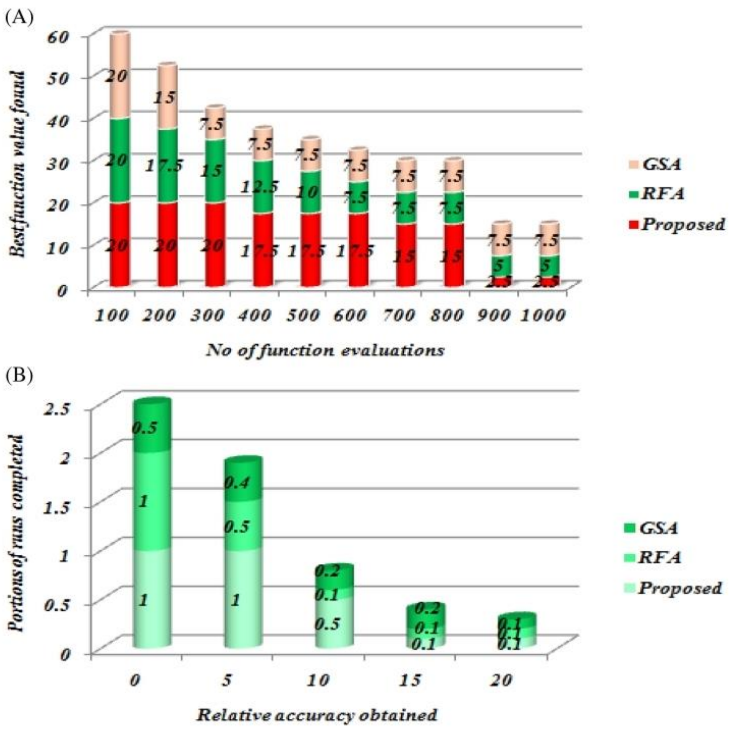
Performance of, A, fitness of proposed; B, fitness comparison



Comparative measures



CONCLUSION

an EVORFA technique for power quality development at grid-connected hybrid power system with battery storage without impacting its normal function of real power transfer was proposed. By utilizing EVOA, the per-fect combination of parameters was generated and the optimal control signals were predicted using RFA technique. Likewise, the current imbalance, current harmonics, load reactive power were efficiently compensated by unbalanced nonlinear load

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linked to point of common coupling, that is, grid side current was balanced sinusoidal in UPF. The sim- ulation results of EVORFA approach is validated in MATLAB/Simulink work site. The final results achieved on the proposed system analyze the possibility and efficiency of the EVORFA approach for eliminating the PQ problems such as THD. The experimental results demonstrated the EVORFA technique was highly proficient in dealing with power quality reinforcement when likened to the existing techniques. The comparative analysis demonstrates the proposed EVORFA technique was more effective on PQ development system than the other existing techniques. Finally, the EVORFA approach performance is more efficient than the other existing approaches depending on DC-link voltage profile enhancement, THD minimization, and better response of hybrid power system.

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SUMMARY

In grid-connected systems, PQ mitigation in HRES has been an attractive field of research. Within the load side, the use of unbalanced loads, non-linear loads, and high frequency switching characteristics is increasing, generating power quality issues in the system. FACT device is among the promising ways for decreasing power quality problems. In this thesis, four advanced controllers are preferred for the mitigation of PQ issues. The first method is ESA optimization-based VSI is used for the reduction of THD. The second approach is of GWO based FOPID in SAPF and SHAPF controller is preferred for mitigation of voltage and current under sag condition. The third approach is ASO based UPQC to mitigate sag, swell and disturbances in the system. VSI control the voltage problems but UPQC contain two VSI which control both current and voltage related issues respectively. Forth approach is EVORFA is an intelligent technique which controls both grid side and generation side nonlinearities and unbalancing issues and provide a constant power flow. Four advanced controlling systems are low in capital cost and free from maintenance. In contrast with the previous methods, the advanced controlling system is less in harmonic level, and provide high active and reactive power. The advanced approaches are very simple to implement and provide a more effective result in contrast to the present approach. The future scope of the HEV system is discussed below section.

Future Scope

- A Hybrid (DC-DC-AC) converter is developed and verified.
- In changeable atmospheric conditions, a hybrid Maximum PowerPoint tracking approach can be utilised to determine the optimal point.
- Manage regulator may be established to function the complete system of PV combined main grid.
- The life cycle of a battery is key research of many researchers. Because alternate of the new battery causes economic loss. A low economic device is placed to secure the battery without any problem.
- Wind turbines are an environmentally favourable power generation method, however, they have a high initial investment cost and require more acreage for