

Figure.1. Proposed Shunt Active Filter

By forcing the grid current to be sinusoidal, the APF must provide the harmonic currents for the load, following the basic current summation rule.

$$i_s(t) = i_l(t) - i_c(t) \quad (1)$$

Where $i_s(t)$, $i_l(t)$, $i_c(t)$ are the instantaneous value of source current, load current and the filter current.

III. ACTIVE FILTER DESIGN USING SDM METHOD

A. Compensating currents calculation

The principle of this algorithm is similar to those presented in [12][15] where the compensation strategy of the SAPF is based on the requirement that the source current need to be balanced, undistorted and in phase with the positive sequence source voltage. In this algorithm we assumed that: -Voltage is not distorted. Accordingly, the active filter will be able to achieve the unity power factor, minimal active power absorbed or supplied by the active filter, and compensation of harmonic currents and reactive power. To reach these goals, the desired three-phase source currents must be in phase with the positive sequence fundamental voltage components.

$$i_{sa} = I_{sm} \sin(\omega t + \phi) \quad (2)$$

$$i_{sb} = I_{sm} \sin(\omega t + \phi - 2\pi/2) \quad (3)$$

$$i_{sc} = I_{sm} \sin(\omega t + \phi + 2\pi/2) \quad (4)$$

$$v_{sa} = V_{sm} \sin(\omega t + \phi) \quad (5)$$

$$v_{sb} = V_{sm} \sin(\omega t + \phi - 2\pi/2) \quad (6)$$

$$v_{sc} = V_{sm} \sin(\omega t + \phi + 2\pi/2) \quad (7)$$

The instantaneous load $P_L(t)$ is obtained by the following equation:

$$P_L(t) = v_{sa} \cdot i_{sa} + v_{sb} \cdot i_{sb} + v_{sc} \cdot i_{sc} \quad (8)$$

The peak reference current I_{sm} is computed as the sum of two components:

$$I_{sm} = I_{mp} + I_{mr} \quad (9)$$

Where:

- I_{mp} is the reference value of the current component in the load.
- I_{mr} is the reference value of the peak current component in the SAPF.

The reference value of the current component to the load I_{mp} is computed using the measured average load power P_{ave} .

$$P_{ave} = \frac{1}{T} \int_0^T P_L(t) dt \quad (10)$$

$$I_{sm} = (2/3) P_{ave} / V_{sm} \quad (11)$$

Regarding the requirement of null average real power consumed or supplied by the SAPF we have the following equation:

$$P_s = P_{ave} \quad (12)$$

The reference value of the peak current component to the SAPF I_{mr} is computed using the parameters of PI regulator and the desired capacitor voltage V_{dc} .

The three phase instantaneous reference source current ($i^*_{sa}, i^*_{sb}, i^*_{sc}$) are computed using I_{sm} and unit templates ($i_{msa}, i_{msb}, i_{msc}$) which derived from the source voltages (v_{sa}, v_{sb}, v_{sc}) and the peak value V_{sm} .

$$\begin{aligned} i_{msa} &= v_{sa} / V_{sm} \\ i_{msb} &= v_{sb} / V_{sm} \\ i_{msc} &= v_{sc} / V_{sm} \end{aligned} \quad (13)$$

The reference currents are then given as in the following equation:

$$\begin{aligned} i_{sa}^* &= I_{sm} \cdot i_{msa} \\ i_{sb}^* &= I_{sm} \cdot i_{msb} \\ i_{sc}^* &= I_{sm} \cdot i_{msc} \end{aligned} \quad (14)$$

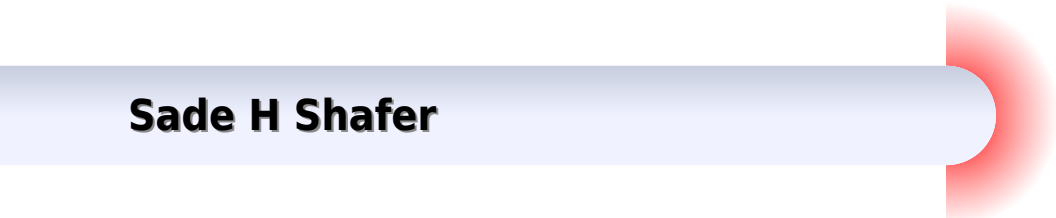
Therefore, the desired compensation of the SAPF currents ($i^*_{ca}, i^*_{cb}, i^*_{cc}$) are determined by this equation:

$$\begin{aligned} i_{ca}^* &= i_{sa} - i_{sa} \\ i_{cb}^* &= i_{sb} - i_{sb} \\ i_{cc}^* &= i_{sc} - i_{sc} \end{aligned} \quad (15)$$

The compensating currents and injecting currents at PCC are compared to generate PWM pulses in order to command VSI (voltage source inverters) switches as shown in figure.2.

Detection Of Harmonic Loads On A Power System Under

Sade H Shafer



Detection Of Harmonic Loads On A Power System Under:

Detection of Harmonic Loads on a Power System Under Practical Conditions of Non-sinusoidal Voltages and Variable Frequency Naveen Jaluria, Purdue University. School of Electrical Engineering, 1993 **Masters Theses in the Pure and Applied Sciences** Wade H. Shafer, 2012-12-06 Masters Theses in the Pure and Applied Sciences was first conceived published and disseminated by the Center for Information and Numerical Data Analysis and Synthesis CINDAS at Purdue University in 1957 starting its coverage of theses with the academic year 1955 Beginning with Volume 13 the printing and dissemination phases of the activity were transferred to University Microfilms Xerox of Ann Arbor Michigan with the thought that such an arrangement would be more beneficial to the academic and general scientific and technical community After five years of this joint undertaking we had concluded that it was in the interest of all concerned if the printing and distribution of the volumes were handled by an international publishing house to assure improved service and broader dissemination Hence starting with Volume 18 Masters Theses in the Pure and Applied Sciences has been disseminated on a worldwide basis by Plenum Publishing Corporation of New York and in the same year the coverage was broadened to include Canadian universities All back issues can also be ordered from Plenum We have reported in Volume 38 thesis year 1993 a total of 13 787 thesis titles from 22 Canadian and 164 United States universities We are sure that this broader base for these titles reported will greatly enhance the value of this important annual reference work While Volume 38 reports theses submitted in 1993 on occasion certain universities do report theses submitted in previous years but not reported at the time

Energy Efficiency of Modern Power and Energy Systems Shady H E Abdel Aleem, Murat Erhan Balci, Muhyaddin Jamal Hosin Rawa, 2024-08-15 Energy Efficiency and Management of Power and Energy Systems introduces students and researchers to a broad range of power system management challenges technologies and solutions This book begins with an analysis of system technology s current state the most pressing problems and the background to challenges in integrating renewable energy sources Technologies including smart grids green building and worker requirements are covered Subsequent chapters break down potential management solutions including specific problem solving for solar wind and hybrid systems Finally specific case studies from a global geographical range zero in on critical questions facing the present industry Providing meticulously researched literature reviews for guiding deeper reading Energy Efficiency and Management of Power and Energy Systems leads readers from contextual understanding to specific case studies and solutions for sustainable power systems Addresses the challenges and solutions related to integrating renewable energy sources into the power grid focusing on maintaining power quality and enhancing energy efficiency Provides a comprehensive reference with extensive guidance on deeper reading Develops understanding and solution design using case studies from a global range of geographies with differing power needs and resources Guides readers through evaluation and analysis of the capabilities and limitations of a range of modern technologies **Computer, Communication and Electrical Technology** Debatosh

Guha,Badal Chakraborty,Himadri Sekhar Dutta,2017-03-16 The First International Conference on Advancement of Computer Communication and Electrical Technology focuses on key technologies and recent progress in computer vision information technology applications VLSI signal processing power electronics drives and application of sensors transducers etc Topics in this conference include Computer Science This conference encompassed relevant topics in computer science such as computer vision intelligent system networking theory and application of information technology Communication EngineeringTo enhance the theory technology of communication engineering ACCET 2016 highlighted the state of the art research work in the field of VLSI optical communication and signal processing of various data formatting Research work in the field of microwave engineering cognitive radio and networks are also included Electrical Technology The state of the art research topic in the field of electrical instrumentation engineering is included in this conference such as power system stability protection non conventional energy resources electrical drives and biomedical engineering Research work in the area of optimization and application in control measurement instrumentation are included as well **Harmonics, Power Systems, and Smart Grids** Francisco C. De La Rosa,2017-07-12 Harmonics Power Systems and Smart Grids Second Edition compiles the most relevant aspects of harmonics in a way that the unfamiliar reader can better grasp the subject matter and the experienced reader can directly access specific subjects of interest The text begins with a definition of harmonics along with analytical expressions for electrical parameters under nonsinusoidal situations and then Discusses important and widely used industry standards to control harmonic distortion levels Describes methods to mitigate the effects of harmonics detailing the operation principles and design of passive filters and active filter fundamentals Presents alternative methods such as stiffer AC sources power converters with increased number of pulses series reactors and load reconfiguration Reviews the elements that play a role in the study of the propagation of harmonic currents in a distribution network Explains how to determine power losses in electrical equipment attributed to harmonic waveform distortion Covers harmonics from solar and wind power converters and power electronics in FACTS and HVDC technologies Explores harmonics from electric vehicles connected to the grid superconductive fault current limiters and electric vehicle charging stations Featuring three new chapters a number of new examples and figures and updates throughout Harmonics Power Systems and Smart Grids Second Edition provides a comprehensive reference on harmonic current generation propagation and control in electrical power networks including the broadly cited smart grid **Distribution Power Systems and Power Quality** Birgitte Bak-Jensen,2020-06-16 High penetration of fluctuating renewable power units such as wind turbines and photo voltaic systems and new heavy loads such as electrical vehicles and heat pumps which so far might not be controlled according to the actual distribution grid condition but rather according to actual consumption of the devices influences the distribution grid in several ways and it may lead to voltage disturbances frequency deviations and harmonic content beyond limits Over voltages might be generated at power production which is too high whereas under voltage might occur at heavy load

situations both phenomena might be seen at the same distribution radial where harmonic injections can also come from the devices if equipped with power converters This has led to the main target object for this book being power quality in distribution grids This book offers 10 papers regarding power quality issues at distribution grids It looks into hosting capacity issues stability analysis reliability assessment mitigation of voltage rise using reactor installation power quality assessments harmonic analysis and damping frequency control in weak and isolated power systems and the focus is therefore broad within the overall topic of power quality

Proceedings of the 1995 World Congress on Neural Networks

Joseph T. DeWitte, 2019-02-21 Centered around major topic areas of both theoretical and practical importance the World Congress on Neural Networks provides its registrants from a diverse background encompassing industry academia and government with the latest research and applications in the neural network field

Smart Grid Opportunities and Challenges in Integrating Renewable Energies Muhammad Faizan Tahir, Salah Kamel, Jose Luis Domínguez-García, Khalid Mehmood Cheema, Kashif Mehmood, 2023-06-27

Grid-Scale Energy Storage Systems and Applications Fu-Bao Wu, Bo Yang, Ji-Lei Ye, 2019-06-11 Grid Scale Energy Storage Systems and Applications provides a timely introduction to state of the art technologies and important demonstration projects in this rapidly developing field Written with a view to real world applications the authors describe storage technologies and then cover operation and control system integration and battery management and other topics important in the design of these storage systems The rapidly developing area of electrochemical energy storage technology and its implementation in the power grid is covered in particular detail Examples of Chinese pilot projects in new energy grids and micro grids are also included Drawing on significant Chinese results in this area but also including data from abroad this will be a valuable reference on the development of grid scale energy storage for engineers and scientists in power and energy transmission and researchers in academia Addresses not only the available energy storage technologies but also topics significant for storage system designers such as technology management operation and control system integration and economic assessment Draws on the wealth of Chinese research into energy storage and describes important Chinese energy storage demonstration projects Provides practical examples of the application of energy storage technologies that can be used by engineers as references when designing new systems

Grid Converters for Photovoltaic and Wind Power Systems Remus Teodorescu, Marco Liserre, Pedro Rodriguez, 2011-07-28 Grid converters are the key player in renewable energy integration The high penetration of renewable energy systems is calling for new more stringent grid requirements As a consequence the grid converters should be able to exhibit advanced functions like dynamic control of active and reactive power operation within a wide range of voltage and frequency voltage ride through capability reactive current injection during faults grid services support This book explains the topologies modulation and control of grid converters for both photovoltaic and wind power applications In addition to power electronics this book focuses on the specific applications in photovoltaic wind power systems where grid condition is an essential factor With a

review of the most recent grid requirements for photovoltaic and wind power systems the book discusses these other relevant issues modern grid inverter topologies for photovoltaic and wind turbines islanding detection methods for photovoltaic systems synchronization techniques based on second order generalized integrators SOGI advanced synchronization techniques with robust operation under grid unbalance condition grid filter design and active damping techniques power control under grid fault conditions considering both positive and negative sequences Grid Converters for Photovoltaic and Wind Power Systems is intended as a coursebook for graduated students with a background in electrical engineering and also for professionals in the evolving renewable energy industry For people from academia interested in adopting the course a set of slides is available for download from the website www.wiley.com/go/grid_converters

Advances in Computer Science, Environment, Ecoinformatics, and Education, Part II Sally Lin, Xiong Huang, 2011-08-09 This 5 volume set CCIS 214 CCIS 218 constitutes the refereed proceedings of the International Conference on Computer Science Environment Ecoinformatics and Education CSEE 2011 held in Wuhan China in July 2011 The 525 revised full papers presented in the five volumes were carefully reviewed and selected from numerous submissions The papers are organized in topical sections on information security intelligent information neural networks digital library algorithms automation artificial intelligence bioinformatics computer networks computational system computer vision computer modelling and simulation control databases data mining e learning e commerce e business image processing information systems knowledge management and knowledge discovering multimedia and its application management and information system mobile computing natural computing and computational intelligence open and innovative education pattern recognition parallel and computing robotics wireless network web application other topics connecting with computer environment and ecoinformatics modeling and simulation environment restoration environment and energy information and its influence on environment computer and ecoinformatics biotechnology and biofuel as well as biosensors and bioreactor **Smart Metering Design and Applications** K.S.K Weranga, Sisil Kumarawadu, D. P. Chandima, 2013-10-04 Taking into account the present day trends and the requirements this Brief focuses on smart metering of electricity for next generation energy efficiency and conservation The contents include discussions on the smart metering concepts and existing technologies and systems as well as design and implementation of smart metering schemes together with detailed examples **DC Microgrids** Nikita Gupta, Mahajan Sagar Bhaskar, Sanjeevikumar Padmanaban, Dhafer Almakhlles, 2022-05-26 DC MICROGRIDS Written and edited by a team of well known and respected experts in the field this new volume on DC microgrids presents the state of the art developments and challenges in the field of microgrids for sustainability and scalability for engineers researchers academicians industry professionals consultants and designers The electric grid is on the threshold of a paradigm shift In the past few years the picture of the grid has changed dramatically due to the introduction of renewable energy sources advancements in power electronics digitalization and other factors All these

megatrends are pointing toward a new electrical system based on Direct Current DC DC power systems have inherent advantages of no harmonics no reactive power high efficiency over the conventional AC power systems Hence DC power systems have become an emerging and promising alternative in various emerging applications which include distributed energy sources like wind solar and Energy Storage System ESS distribution networks smart buildings remote telecom systems and transport electrification like electric vehicles EVs All these applications are designed at different voltages to meet their specific requirements individually because of the lack of standardization Thus the factors influencing the DC voltages and system operation needed to be surveyed and analyzed which include voltage standards architecture for existing and emerging applications topologies and control strategies of power electronic interfaces fault diagnosis and design of the protection system optimal economical operation and system reliability

Intelligent Computing in Signal Processing and Pattern Recognition De-Shuang Huang, George William Irwin, 2006-09-08 This 1179 page book assembles the complete contributions to the International Conference on Intelligent Computing ICIC 2006 one volume of Lecture Notes in Computer Science LNCS one of Lecture Notes in Artificial Intelligence LNAI one of Lecture Notes in Bioinformatics LNBI and two volumes of Lecture Notes in Control and Information Sciences LNCIS Include are 149 revised full papers and a Special Session on Computing for Searching Strategies to Control Dynamic Processes

Power Quality in Power Systems and Electrical Machines Ewald F. Fuchs, Mohammad A. S. Masoum, 2011-08-29 Power Quality in Power Systems and Electrical Machines Second Edition helps readers understand the causes and effects of power quality problems and provides techniques to mitigate these problems Power quality is a measure of deviations in supply systems and their components and affects all connected electrical and electronic equipment including computers TV monitors and lighting In this book analytical and measuring techniques are applied to power quality problems as they occur in central power stations and distributed generation such as alternative power systems Provides theoretical and practical insight into power quality problems most books available are either geared to theory or practice only Problems and solutions at the end of each chapter dealing with practical applications Includes application examples implemented in SPICE Mathematica and MATLAB

Modeling, Identification and Control Methods in Renewable Energy Systems Nabil Derbel, Quanmin Zhu, 2018-12-24 Most of the research and experiments in the fields of modeling and control systems have spent significant efforts to find rules from various complicated phenomena by principles observations measured data logic derivations The rules are normally summarized as concise and quantitative expressions or models Identification provides mechanisms to establish the models and control provides mechanisms to improve system performances This book reflects the relevant studies and applications in the area of renewable energies with the latest research from interdisciplinary theoretical studies computational algorithm development to exemplary applications It discusses how modeling and control methods such as recurrent neural network Pitch Angle Control Fuzzy control Sliding Mode Control and others are used in renewable systems

It covers topics as photovoltaic systems wind turbines maximum power point tracking batteries for renewable energies solar energy thermal energy and so on This book is edited and written by leading experts in the field and offers an ideal reference guide for researchers and engineers in the fields of electrical electronic engineering control system and energy IAS '98 IEEE Industry Applications Society. Meeting,1998 *Electric, Electronic and Control Engineering* Fun Shao,Wise Shu,Tracy Tian,2015-07-03 Electric Electronic and Control Engineering contains the contributions presented at the 2015 International Conference on Electric Electronic and Control Engineering ICEECE 2015 Phuket Island Thailand 5 6 March 2015 The book is divided into four main topics Electric and Electronic Engineering Mechanic and Control Engineering Informati *Active Power Line Conditioners* Patricio Salmeron Revuelta,Salvador Pérez Litrán,Jaime Prieto Thomas,2015-07-31 Active Power Line Conditioners Design Simulation and Implementation for Improving Power Quality presents a rigorous theoretical and practical approach to active power line conditioners one of the subjects of most interest in the field of power quality Its broad approach offers a journey that will allow power engineering professionals researchers and graduate students to learn more about the latest landmarks on the different APLC configurations for load active compensation By introducing the issues and equipment needs that arise when correcting the lack of power quality in power grids this book helps define power terms according to the IEEE Standard 1459 Detailed chapters discuss instantaneous reactive power theory and the theoretical framework that enabled the practical development of APLCs in both its original and modified formulations along with other proposals Different APLCs configurations for load compensation are explored including shunt APF series APF hybrid APF and shunt combined with series APF also known as UPQC The book includes simulation examples carefully developed and ready for download from the book s companion website along with different case studies where real APLCs have been developed Finally the new paradigm brought by the emergence of distribution systems with dispersed generation such as the use of small power units based on gas technology or renewable energy sources is discussed in a chapter where mitigation technologies are addressed in a distributed environment Combines the development of theories control strategies and the most widespread practical implementations of active power line conditioners along with the most recent new approaches Details updated and practical content on periodic disturbances mitigation technologies with special emphasis on distributed generation systems Includes over 28 practical simulation examples in Matlab Simulink which are available for download at the book s companion website with 4 reproducible case studies from real APLCs **Next-Generation Green Energy Technologies for Sustainable Development** Surender Reddy Salkuti,2025-10-31 This book aims to find solutions to various issues starting from integration and control of next generation grids hybrid power generation electric vehicles energy storage forecasting wide area monitoring electrical markets communication coordinated control and protection empowering the customer with tools for optimizing their energy consumption and security for the effective reliable and risk free operation of the power networks There is a requirement to conduct a comprehensive analysis of the integration of a large number of

EVs and their impact on various sectors of society This book also discusses the applications of advanced power electronics intelligent control techniques effective energy management EV charging networks the impact of EV load on distribution systems economic analysis and power markets advanced flexibility strategies for smart grids recent advances in energy storage and research directions emerging fields such as artificial intelligence internet of things and machine learning Several developments in green energy technologies have gained momentum in recent years This book considers the nuances of new paradigms including green energy technologies smart grid components the impact of energy storage electric vehicles and distributed energy resources in the power networks It provides illustrative and comprehensive strategies to furnish pragmatic solutions to multifaceted challenges ushering in a new era of heightened efficiency unwavering reliability and enhanced overall performance in modern smart and hybrid energy systems

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