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ARTICLE
Spatial Management of Distributed Social Systems

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ABSTRACT

The paper describes the use of invented, developed, and tested in different countries of the high-level spatial grasp model and technology capable of solving important problems in large social systems, which may be represented as dynamic, self-evolving and distributed social networks. The approach allows us to find important solutions on a holistic level by spatial navigation and parallel pattern matching of social networks with active self-propagating scenarios represented in a special recursive language. This approach effectively hides inside the distributed and networked language implementation traditional system management routines, often providing hundreds of times shorter and simpler high-level solution code. The paper highlights the demands to efficient simulation of social systems, briefs the technology used, and provides some programming examples for solutions of practical problems.

1. Introduction

Social systems and social networks expressing them may be large and complex [1-4]. Consisting of numerous nodes and links between them and constantly changing their volume and structure, they may cover separate countries and the whole world. Proper dealing with such systems is crucial for the world's security and prosperity. This needs their detailed simulation and integration with live control and management within united concepts of virtual, physical and executive worlds. The current paper, based on previous publications [5-11], provides advanced approach for analysis of large social systems, which may have effective implementation on different platforms, also with the use of existing media systems and channels. The rest of this paper is organized as follows. In section 2, main demands to the simulation and support of distributed social systems are listed. Section 3 briefs the developed Spatial Grasp Technology allowing us to effectively deal with very large social networks, which may have worldwide distribution, including its high-level recursive Spatial Grasp Language (SGL) and organization of its networked interpreter. Section 4 provides examples of using SGL for describing very practical social problems, and Section 5 concludes the paper.

2. Demands to Social Systems Simulation and Support

Traditional centralized access, copying, and visualization

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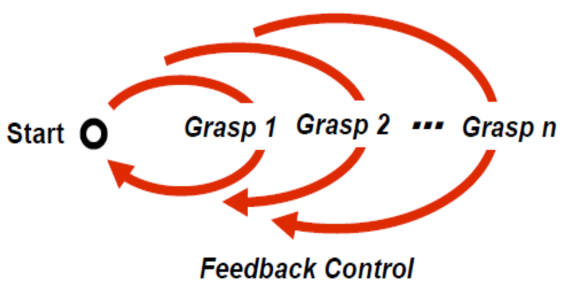
of social networks may not satisfy the needs as requiring unacceptable amount of time, storage, and computing resources, and the obtained network snapshots of these highly dynamic worlds are rapidly becoming outdated. The really suitable solutions may be achieved by massive and parallel and runtime dealing with social networks directly in points where the original information occurs. Within this context, we will be using the patented high-level Spatial Grasp Technology (SGT) already tested on different networked applications and described in Wiley, Springer and Emerald books [5-7, 9, 10], which allows us to find holistic solutions in large social systems by treating the whole distributed world as an integral spatial brain.

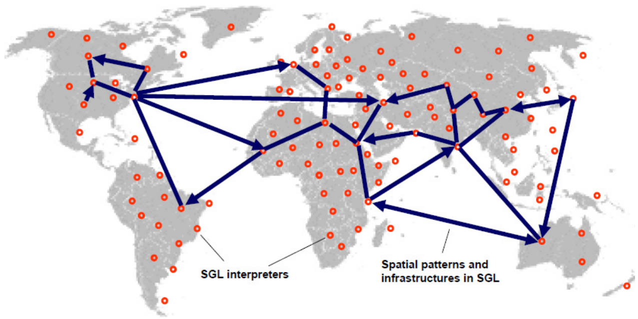
3. Spatial Grasp Technology Basics

3.1 General SGT Idea

Within SGT, a high-level scenario for any task to be performed in a distributed world is represented as an active self-evolving pattern rather than traditional sequential or parallel program. This pattern, expressing direct world vision, perception and top semantics of the problem to be solved, is written in a high-level Spatial Grasp Language (SGL). Starting from any world point (which may be multiple and arbitrarily distributed) it *spatially self-propagates, self-replicates, self-modifies, self-covers and self-matches* the distributed world in parallel wavelike mode. If needed, it also echoes back the reached control states and data discovered or obtained (which may happen to be arbitrarily remote, say, half-world away) for making decisions at higher levels and further space navigation from the reached positions, which may include the starting and any previous ones (see Figure 1,a). The self-spreading & self-matching SGL patterns-scenarios can dynamically create and leave any *knowledge infrastructures* arbitrarily distributed between system components which may cover any regions, the whole world including, as in Figure 1,b.



a



b

Figure 1. Controlled navigation of distributed spaces with creation of distributed infrastructures

Arbitrary number of spatial processes in SGL can start any time and in any places, cooperating or competing with each other, and these spatial processes can be organized on certain agreements (as in the past for the previous technology version, WAVE, installed at different universities of Germany, UK, US, and Canada [9-10]), or represent specific stealth solutions for particular purposes, depending on applications. The created infrastructures, which may remain active and capable of evolving further at any time (including self-launching new spatial SGL scenarios) can effectively support or express distributed databases, advanced command and control, situation awareness, autonomous and collective decisions. They can express or mimic any existing or hypothetical computational and/or control models, effectively integrate distributed simulation and real control with runtime changing watershed in between, and even provide a sort of self-consciousness for highly intelligent and arbitrarily distributed systems.

3.2 Spatial Grasp Language

General SGL organization is as follows (with full syntax just on a single page, see [5-7]), where syntactic categories are shown in italics, vertical bar separates alternatives, parts in braces indicate zero or more repetitions with a delimiter at the right, if multiple, and constructs in brackets may be optional:

grasp → *constant* | *variable* | [*rule*] [({ *grasp*,})]

constant → *information* | *matter* | *custom* | *special* | *grasp*

variable → *global* | *heritable* | *frontal* | *nodal* | *environmental*

rule → *type* | *usage* | *movement* | *creation* | *echoing* | *verification* | *assignment* | *advancement* | *branching* | *transference* | *exchange* | *timing* | *qualifying* | *grasp*

An SGL scenario, called *grasp*, applied in some

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point (or points) of the distributed space, can just be a *constant*, a *variable*, and can also be a *rule* (expressing certain action, control, description or context) optionally accompanied with operands separated by comma (if multiple) and embraced in parentheses. These operands can be of any nature and complexity (including arbitrary scenarios themselves) and defined recursively as *grasp,* i.e. can be constants, variables or any rules with operands (i.e. as grasps again), and so on. Rules, starting in some world point, can organize navigation of the world sequentially, in parallel, or any combinations. They can result in staying in the same application point (which can also serve as starting point for further navigation) or can cause movement to other world points with obtained results to be left there, as in the rule's final points, form which to proceed further. Such results can also be returned to the rule's starting point, from which the rest of the scenario, if any, can develop. The rules, due to recursive language organization, can form arbitrary operational and control infrastructures covering any spaces and environments and expressing any sequential, parallel, hierarchical, centralized, localized, mixed, and up to fully decentralized and distributed algorithms. SGL may be considered as pursuing a quite different philosophy, methodology, and programming styles, serving as language and tool for *directly dealing with distributed dynamic spaces, both virtual and physical, and not being the language for programming computers and networks,* as usual, which is totally shifted to its automatic implementation.

3.3 SGL Interpreter

The SGL interpreter [7-12] consists of a number of specialized functional processors working with and sharing specific data structures. SGL interpretation network generally serves multiple scenarios or their parallel branches simultaneously navigating the distributed world. Each interpreter can support and process multiple SGL scenario code which appears in its responsibility at different moments of time. Implanted into any distributed systems and integrated with them, the interpretation network (having potentially millions to billions of communicating interpreter copies) allows us to form dynamic and ubiquitous world computer (actually as "spatial brain") with unlimited power for simulation and management of the world itself. Different interpreter copies appear to be dynamically interlinked by *spatial hierarchical track system* which is the result of wavelike navigation of distributed environments in SGL, and this track system effectively supports the overall management and control of highly parallel and fully distributed solutions. This internal system, working in alternating top-down and bottom-up modes, also serves as automatically created and hidden from the user powerful spatial computational, decision-making and distributed knowledge transferring, supporting, and cleaning engine. This allows us to write global SGL scenarios expressing only top semantics of the tasks to be solved, which are often hundreds of times shorter and simpler than under any other approaches for solving similar problems. SGL interpreter can have both software and hardware efficient implementations, with new patent being prepared on it. It can also be deeply integrated with any other existing networking systems and engines, thus deeply penetrating into the distributed social tissue and becoming an inseparable and intelligent part of it.

4. Some Programming Examples

We will consider two very simple programming examples in SGL related to this paper, as follows.

(1) Finding distance between averaged centers of different communities

This example is shown in Figure 2, where different communities in a social network are defined by different type of semantic links between their nodes (like c1 and c2), and such communities may semantically and spatially intersect. After finding topographical centers of communities by the following SGL scenario, if communities are located too close to each other, an "alarm" is issued (say, in case they may be antagonistic to each other).

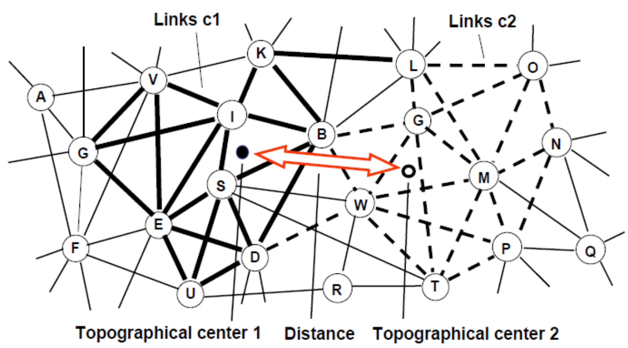

Figure 2. Finding topographical centers and distance between them in a distributed social network

nodal(Center1, Center2, Threshold = …);

Center1 = average(hop(all); if(hop_link(c1), WHERE));

Center2 = average(hop(all); if(hop_link(c2), WHERE));

If (distance(Center1, Center2) > Threshold, output("alarm")

The nodes of social network may not be stationary and can change their positions in time, with accounting this by extending the scenario above as follows, with regular finding migrating topological centers and issuing corresponding alarms.

nodal(Center1, Center2, Shift, Threshold = …);
parallel(
(hop(all); repeat(Shift = random(dX, dY); WHERE + Shift); sleep(delay1))),
repeat(Center1 = average(hop(all); if(hop_link(c1), WHERE))
Center2 = average(hop(all); if(hop_link(c2), WHERE));
if(distance(Center1, Center2) > Threshold, output("alarm")); sleep(delay2))

In a further extension of this scenario we may allow nodes to create new links with other nodes at runtime, also lose the existing ones.

(2) Human-robotic teaming

This is symbolically depicted in Figure 3, where communicating humans and robots (all treated as "units) are randomly swarming and supposedly eliminating the discovered unwanted objects (as "targets"), also informing close neighbors (humans or robots) about the targets seen, thus prompting collective actions.

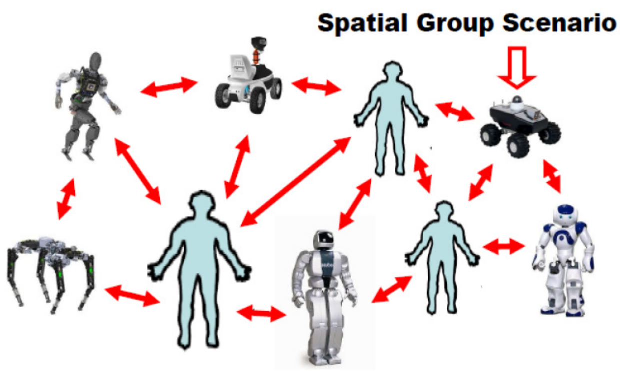

Figure 3. United human-robotic collectives

hop(all_units); repeat(
Shift = random(*dx_dy*);
if(empty(WHERE + Shift), shift(Shift));
append((own, direct_neighbors); Targets), seen(targets));
impact(targets); sleep(*delaytime*)))

This scenario can also have different extensions similar to the previous one, where human-robotic collectives may dynamically organize runtime hierarchies (with higher levels potentially occupied by robots too) improving their collective vision and cooperative fight with unwanted objects. Such human-robotic collectives can have holistic qualities and capabilities in SGL (see possible formalization of gestalt theory laws under SGT [6-7]), they can even have a sort of distributed consciousness for very complex and important applications, especially for crises management and defense.

5. Conclusion

The main advantage of the philosophy, methodology and technology developed is that it operates in both simulated and actual worlds, with feeling of direct presence and free movement in them. And all this can be expressed within the same formalism and very high level language enabling us to hide most of traditional systems management routines inside its fully distributed, parallel and intelligent implementation. This paradigm, known as WAVE in the past [9,10] has some relation to mobile agents (having appeared well before them), but it navigates and grasps distributed spaces holistically and globally, also leaving active spatial infrastructures which may cover the whole world. This is quite different from traditional agents-based and interoperability philosophies which consider the system as consisting from well defined autonomous parts which need to be interlinked and integrated by some additional means, which often does not work properly. The technology developed can also be symbolically considered as unlimitedly powerful world super-virus, which has enormous power not only to kill but also create, restructure, improve, and rule the world. One of its currently investigated applications is simulation of global pandemics and spatial methods of fighting them. Another considered application—global missile defence systems, both terrestrial and celestial, especially for withstanding very high speed dangerous objects which may have tricky routes. Concerning social networks, the tech offered can effectively combine distributed interactive simulation of large social systems with their effective management, with watershed between the two regulated at runtime within the symbiotic simulation-control SGL scenarios. Other investigated applications include advanced mosaic-type operations in distributed systems, simulation of such complex features as awareness and consciousness, also technological support of space conquest and advanced terrestrial and celestial missions. SGL can be quickly implemented even within standard university environments, similar to its previous versions in different countries under the author's supervision.

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ARTICLE

Research on the Computer Software Testing Method Based on Multiple Platforms

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ABSTRACT

Informationization plays an important role in modern life and production. And various software is one of the bases for it. Before it goes into service, software needs to go through many steps, including software development, design, etc. In software development, test is the key to identify and control bugs and errors in the software. Therefore, software companies often test the software to ensure that it is qualified. In recent years, more attention has been paid to a multi-platform computer software testing method, which can make up for defects in traditional testing methods to improve test accuracy. Firstly, this paper illustrates the connotation and features of software testing. Secondly, common software testing platforms and their requirements are analyzed. Finally, this paper proposes software testing method based on multiple platforms.

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1. Introduction

Computer as well as Internet is one of the essential conditions in the operation of modern society. When people use them, many application software will be installed in computers. Hence, software development and testing industry emerges accordingly. To improve the quality of software, software development companies routinely test the software after designing process so as to identify bugs in it. However, due to its particularity, perfect software does not exist in reality. The more complex the software is, the more likely bugs exist. In this case, the purpose of software testing is not to eliminate all bugs, but to fix the identified problems. In order to identify more bugs, it is common to choose multiple platforms for software testing. At present, there are many platforms used in software testing, so the optimal platform should be selected according to features of software. Only in this way can we ensure that as many bugs as possible will be identified to guarantee the security of software applications.

2. The Concept and Features of Software Testing

2.1 The Concept of Software Testing

Software testing appears as software development industry develops. At the initial stage of software development, software features small scale and less complexity [1].

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There are many problems such as disordered process and randomness in the development while the corresponding test connotation is relatively narrow. Developers directly consider the testing as debugging, whose purpose is to correct the identified bugs in the software, and most developers complete the work by themselves. In this stage, software companies lack necessary attention to the testing. Meanwhile, the testing, which is relatively late, is carried out when the code is formed and the product is basically completed in most cases [2].

With further development of software industry, the software is gradually promoted to large-scale and complex development. In this stage, some basic theories and techniques of software testing are gradually formed, and people began to design a lot of flow tables and management plans for software development. The software has evolved from disordered development to structured development, mainly featuring structured analysis and design, structured review and so on. At this stage, the concept of quality is incorporated into software development and testing, so the definition of software testing changes accordingly. Testing is not simply a behavior of identifying errors, but also the main part of software quality assurance, covering the content of software quality evaluation [3].

Software testing was defined in software engineering terminology proposed by IEEE in 1983. Specifically, the process of a certain software system should be operated or measured manually or automatically. The function of software measurement is to find out whether the software meets the design requirements or to ascertain the differences between expected results and actual results [4]. This definition further clarifies the purpose of software testing. It’s no longer a one-time event, but an integral part of the development process.

2.2 Features of Software Testing

During software testing conducted by software testing platforms, relevant workers need to build a good operating environment to ensure that no trouble will appear during the process [5]. Meanwhile, software test platforms’ accuracy of results and rate of process will be improved. In addition, hidden bugs in the software can also be identified and fixed in time. Workers should be aware that the operating environment has an important impact on smooth implementation of software testing. All software should be tested before actual application [6]. However, with the rapid development of modern information technology, software updates at a very fast speed and software functions become increasingly complex. These facts greatly increase the difficulty of software testing and put forward higher requirements for software testing platforms. During software testing, for one thing, relevant workers need to compare and access the test setting for a function. For another, they also need to avoid interfering with other functions of the software. The above specifications aim to continuously improve efficiency and quality of software test platforms. With the rapid development of information technology, software testing will be applied to various testing platforms. Then the increase of platforms can improve efficiency and accuracy of software testing. It can also perform unified tests on all functions of software to maximize the value of identifying software bugs [7].

Testing principles, specifically the incomplete principle, should be followed before software testing. The incomplete principle means that if the test is not complete and there are many parts with immunity principle in the testing, it can play a positive role in the software testing [8]. Owing to immunity of such factors in software testing, there is a positive correlation between testing content performed by testers and software testing immunity. If people want to make software testing smoother and more accurate, these principles must be followed and be integrated into the whole software development process to achieve continuous testing rather than one-time whole-process testing.

3. Analysis of Software Testing Platforms

3.1 Common Software Testing Platforms

In order to meet the demands of software testing in the maximum degree, the number of platforms applied in the testing process keeps increasing. In recent years, during software testing, software testing platforms such as PARASOFT ALM RUAN, Test Center and so on are commonly used. At the early stage of software testing industry development, PARASOFT carried out various software testings and obtained remarkable fruits[9]. PARASOFT ALM RUAN, successfully developed by the company, is recognized by people among integrated software test platforms. It is mainly because of its comprehensive software testing and the application of this platform by some internationally renowned software testing companies. Test Center, as a general test platform, can perform testing for various types of software. Test Center has the advantages of strong stability and high efficiency during the application, so it is mostly used in software development. Using Test Center can greatly shorten the time of software development, thus improving

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the efficiency of software development and attracting more attention in software testing industry[10].

3.2 Requirements of the Test Based on Multiple Platforms

Based on different characteristics of software, if it is only tested by a specific platform, the obtained test results are bound to lack comprehensiveness. As the software development become more diversified and complex, software testing based on multiple platforms can better meet the development requirements of the whole industry. Software testing based on multiple platforms can effectively detect existing defects that affect user experience in application process on a single platform. During software testing based on multiple platforms, developers need to divide the software operation into various steps in advance, and gradually complete the testing on different platforms. Hence, bugs in various aspects such as functionality and logic can be identified with higher efficiency and accuracy.

4. Specific Methods of Software Testing Based on Multiple Platforms

4.1 Steps of Software Testing Based on Multiple Platforms

The first step is designing and planning, during which appropriate test methods should be chosen according to computer software requirements. The second step is building the model. The required testing model should be built by applying existing computer software testing methods. Based on the logic characteristics of computer software itself, the model building in this period should pay attention to compatibility of software operation from the perspective of logic operation, and build relevant framework to ensure that all testing methods are carried out normally. The third step is managing applications. After model building, the test tasks should be refined in combination with differences among test methods. The differences of test software should be referenced in order to detail the test methods and corresponding tasks, ensuring that all test tasks can run smoothly. The fourth step is practicing. During the operation, attention should paid to the collection of all kinds of information. Combining with the obtained information of errors, people should provide reference for subsequent adjustment of the software.

4.2 Software Testing Standards Based on Multiple Platforms

First, the balance between different platforms should be paid attention to. Given that different test platforms have different developers, it is inevitable that differences of test environments exist, which will lead to problems of software operation adaptability between people during software testing. During testing, coordination between platforms should be ensured in order to choose the best way for testing. Second, due to the complexity of the software, key monitoring points should be selected in advance to improve the efficiency during the test, and the core functions of the software should be defined, based on which the most suitable platform can be selected. In environment of testing with the help of a network platform, the identified problems should be fixed in time, then subsequent inspection should be carried out. All the testing work can be completed only when all problems are solved. Third, during the normal operation of software, its fluency will be affected by the system environment to some extent. Software can vary on different system environments during operation. In view of this, one of the premises for software testing based on multiple platforms should be a good network configuration environment.

5. Conclusion

Modern software updates quickly. Testing, as the key step of its development, requires high efficiency and accuracy. In the past, the software testing on a single platform may incompletely identify bugs or operate with relatively low efficiency. Consequently, this paper proposes software testing patterns based on multiple platforms. It can be seen from the above analysis that software testing based on multiple platforms works more efficiently and comprehensively, being able to get involved in software development in the early stage. Additionally, computer software testing method based on multiple platforms can further improve software stability if it is applied to appropriate software testing platform, thus having great significance for ensuring that the designed software meets requirements.

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ARTICLE

Vector Control of Three-Phase Solar Farm Converters Based on Fictive-Axis Emulation

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ABSTRACT

In this paper, a new method for adjusting the current of three-phase voltage source DC-AC converter in orthogonal (DQ) reference frame is presented. In the DQ reference system, AC variable appears in the constant form of DC, making the controller design the same as the DC-DC converter [1]. It provides controllable gain benefits at the steady-state operating point, and finally realizes zero steady-state error [2]. In addition, the creative analytical model is dedicated to building up a series of virtual quantities orthogonal to the actual single-phase system. In general, orthogonal imaginary numbers get the reference signal by delaying the real quantity by a quarter period. However, the introduction of such time delay makes the dynamic response of the system worse. In this paper, orthogonal quantities are generated from a virtual axis system parallel to the real axis, which can effectively improve the dynamic performance of traditional methods without increasing the complexity of controller structure. Through PSCAD simulation, the ideal experimental results are obtained.

1. Introduction

In the past few years, many researches have been done on VSC control regulation and various methods have been proposed, such as hysteresis, no difference frequency, prediction, proportional integral (PI) and proportional resonance (PR) based control strategies. In general, these methods can be divided into two categories: fixed frame controllers and synchronous frame controllers. Among static frame controllers, the linear PI controller is used intensively in numerous industries. However, since well-known shortcomings such as non-zero steady-state error, other methods have been proposed, such as a PR controller, to track the AC reference signal in the static coordinate system with zero steady-state error [3]. In addition, the PR control is one of the most popular classical control theories that is to implement for single and three-phase applications while providing satisfactory and controllable performance. This part we analyze the controller strategies based on the solar farm system [4].

Secondly, DQ transformation projects the three-phase current of stator a, b and c into the direct axis (D axis), the quadrature axis (Q axis) and the zero axis (0 axis) perpendicular to the DQ plane as the rotor rotates. Thus, it realizes the diagonalization of the stator inductance matrix and simplifying the operation analysis of synchronous

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motor [5]. The transformation from ABC coordinates to DQ coordinates. For the convenience of research, this paper adopts the method of combining DQ transformation and PI control to analyze [6].

The next part gives the control strategy based on virtual axis simulation (FAE). Finally, we evaluate the sensitivity of the proposed method to changes in system parameters and summarizes the paper.

2. Designed System Description

2.1Three-Phase VSC

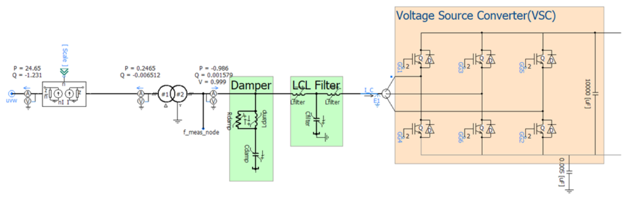

Figure 1. The topology of three-phase VSC

The integrated circuit design of Figure 1 illustrates a three-line diagram of the solar plant application system where the VSC is connected to the utility grid through the combination of line reactor filter that is made of by Damper and LCL filter and a coupling model transformer.

Mainly using steady and high-efficiency control strategy for three-phase VSCs that could be realised according to the innovation of vector control of three-phase electrical systems. Previous vector control methods are pretty popular, where a series of flexible strategies are used to define and change the control system parameters in order to assure predefined dynamic performance and decoupled axes. One of the most convenient methods is simple PI controllers. In the next section, the control structure is briefly introduced [7].

2.2 Current Control Loop

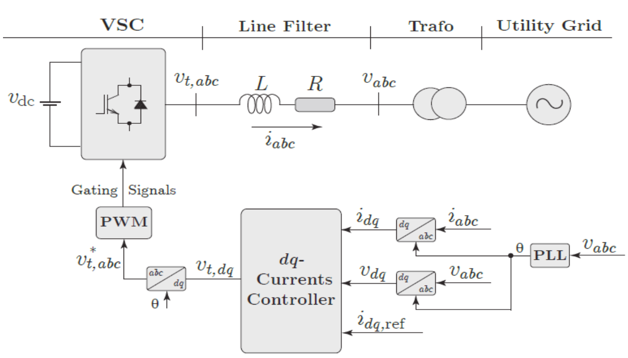

Figure 2. The technological process of dq current controller

Firstly, assuming the variables of single-phase systems are replaced by those of three-phase systems. In this way the dynamics process of the ac-side of solar plant system can be described as

$$V,abc=Ri,abc+L\frac{di,abc}{dt}+ui,abc \tag{1}$$

In the *αβ coordinate system*, it can become

$$V,a\beta=Ri,\alpha\beta+L\frac{di,\alpha\beta}{dt}+ui,\alpha\beta \tag{2}$$

Transforming this equation into the new Laplace domain, a flow diagram of the control strategy in the stationary logical structure is drawn (Figure 3).

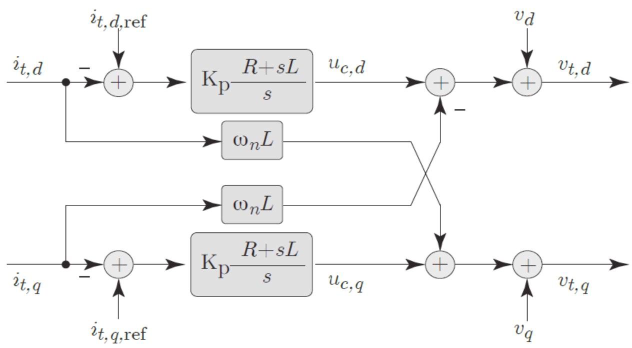

Figure 3. Reference parameter setting frame

The detailed changes of the ac-side variables in the logical frame (*dq* frame) is derived as

$Uad=Ucd-L\omega iq+Uid$;

$Uaq=Ucd+L\omega iq+Uiq$; (3)

id and *iq* are respond to *ucd* and ucq through the first-order integration function, the control strategy is realized through redefining the parameters of closed-loops and using basic first-order PI controllers [8].

Therefore, the integration function of the control strategy is derived as follows, where the time variable *Ts* is equal to *L*/*R*, and *Ks* is equal to 1/*R*:

$$Hs=\frac{Kc}{1+sTs}; (4)$$

And then the transfer function Ho can be defined according to the open-loop structure:

$Ho(s) = HR(s)*Hpe(s)*Hs(s)$; (5)

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Where $HR(s)=\dfrac{1+sTn}{sTi}$, and $Hpe(s)=\dfrac{Kcm}{1+sTpe}$; (6)

2.3 Changing the Basic Current Controller into PQ Controller

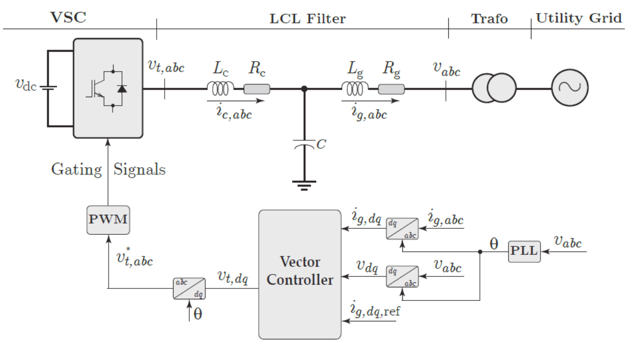

Figure 4. Vector controller with active and reactive power

This section, changing the method of defining reference parameters by using active and reactive power values. It is pretty convenient to control the output power through applying the property of active power whose final power in the DC and AC side is always equal [9].

2.4 Performance Evaluation

The original method of current controlling will produce some inevitable errors. In the climbing process of the preparation stage, the oscillating harmonic generated by the secondary current will have a great influence on the power, which will continue to affect the steady-state output, resulting in a large steady-state error. And from the graphic results, it is obvious that there are large oscillations in the preparation phase.

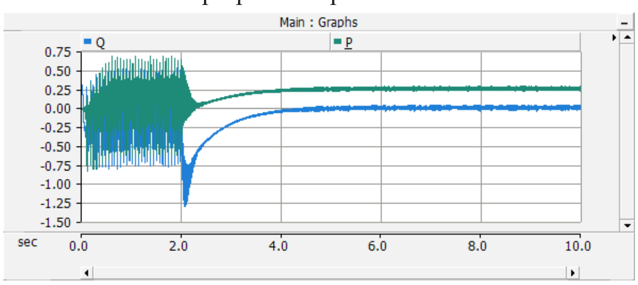

Figure 5. Conventional result of PQ control

In this test, compared with the conventional method, the advanced vector current controller has better performance. The results of testing application demonstrate the innovation strategy of controller has the following advanced properties [10]:

(1) It is realizable to track all reference signals with zero steady-state error within few milliseconds.

(2) It would not impose excessive disruption and strange oscillation to the solar plant application.

(3) It contraries to the traditional method, and it would not be impacted by unregular oscillatory dynamics.

During the steady process, the controller can monitor and correct the current with zero steady-state error by reading continues feedback from loops. And total harmonic distortion (THD) value of the current during this state is 4.5%, which is beneficial for the solar plant to store and deliver current.

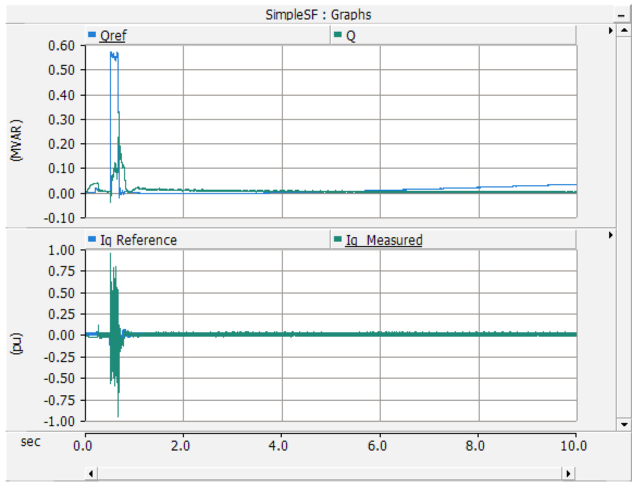

Figure 6. Simulation Results of reference signals (a)

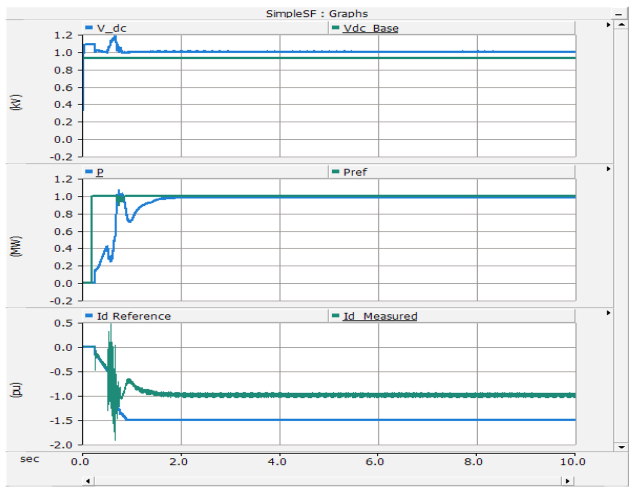

Figure 7. Simulation Results of DC voltage and dq reference values (b)

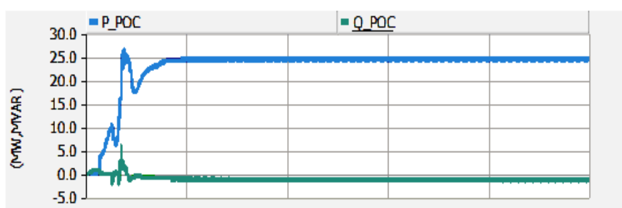

Figure 8. Simulation Results of active and reactive power on the middle position (c)

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Figure 6 Simulation results of the advanced dq current controller: (a) changing values of Q and iq. (b) changing values of P and id. (c) the grid active and reactive power corresponding to the converter current.

3. Conclusion

This paper introduces a new design of vector controller for the current and voltage regulation of three-phase VSCs. Compared with the traditional method, the orthogonal components of voltage and current are generated to meet the needs of a stationary and synchronous controlling frame by the SOGI based on phase locked loop. In addition, conventional methods use phase shifting to generate orthogonal current, which results in poor transient response. However, the controller can produce the expected orthogonal current and physical system and has a higher kinetic advantage. Finally, the performance of the proposed control strategy is evaluated by simulation and experiment compared with the traditional control strategy [11].

The research shows that the proposed method has the following characteristics:

(1) Maintain system stability, track reference value, stability error is zero.

(2) It is much faster than the traditional method.

(3) Compared with traditional methods, it has better dynamic response.

(4) It is robust to inconsistencies between physical axis and virtual axis parameters.

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ARTICLE

Image Segmentation Based on Intuitionistic Type-2 FCM Algorithm

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ABSTRACT

Due to using the fuzzy clustering algorithm, the accuracy of image segmentation is not high enough. So one hybrid clustering algorithm combined with intuitionistic fuzzy factor and local spatial information is proposed. Experimental results show that the proposed algorithm is superior to other methods in image segmentation accuracy and improves the robustness of the algorithm.

1. Introduction

Image segmentation [1,2] is based on dividing the image into regions with different features. Common Image segmentation methods include threshold selection based on region characteristics [3], edge detection [4] based on specific theory. With the development of science and technology in recent years, many researchers combine the special theory with the existing image segmentation technology and propose many new segmentation algorithms [5,6,7]. Mingwu Ren [8] et al used edge pattern histogram to reduce the noise and the threshold effect of Edge on image segmentation.

The structure of this paper is organized as: Part 2 described the proposed method; Part 3 provides the experimental results; Finally, the conclusion is given in the Part 4.

2. Rough Intuitionistic Type-2 Fuzzy c-means Clustering Algorithm

In this paper, a hybrid clustering algorithm combined with a new intuitionistic fuzzy factor and local spatial information is proposed. The proposed algorithm is listed in the following three subsections:

3. Initialization of Cluster Centroids by IT2F Roughness

If the upper and lower approximation of an image I (*m, n*) can be described as $Qi\ (k)$ and $qi\ (k)$, then the IT2F roughness at the kth intensity can be given by:

$$\rho_i(k) = 1 - \frac{|q_i(k)|}{|Q_i(k)|}, 0 \le k \le L-1$$

Where the $qi\ (k)$ and $Qi\ (k)$ can be given as following equation:

$$q_i(k) = \lfloor u_1(x_{ij}) \rfloor, 0 \le i \le M-1, 0 \le j \le N-1$$

$$Q_i(k) = \sum_{m=1}^{M}\sum_{n=1}^{N}(1 + u(m,n)\delta(\lfloor(2^{(bit)}-1) * u_I(x_{ij})\rfloor - k))$$

where $u(m,n) = exp\left(1 - \frac{1}{2}\left(\frac{d(m,n)}{\sigma}\right)^2\right)$ means

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the the Gaussian MF used as type-2 fuzzy memberships, so the total distance of all the pixels can be given as:

$$d(m,n) = \sum_{r\in R}\sum_{t\in T} d(I(m,n),I(r,t))$$
$$= \{\frac{1}{2}((\mu(I(m,n)) - \mu(I(r,t)))^2$$
$$+ (v(I(m,n)) - \pi(I(r,t)))^2$$
$$+ (\pi(I(m,n)) - \pi(I(r,t)))^2\}$$

4. The Intuitionistic Fuzzy Factor

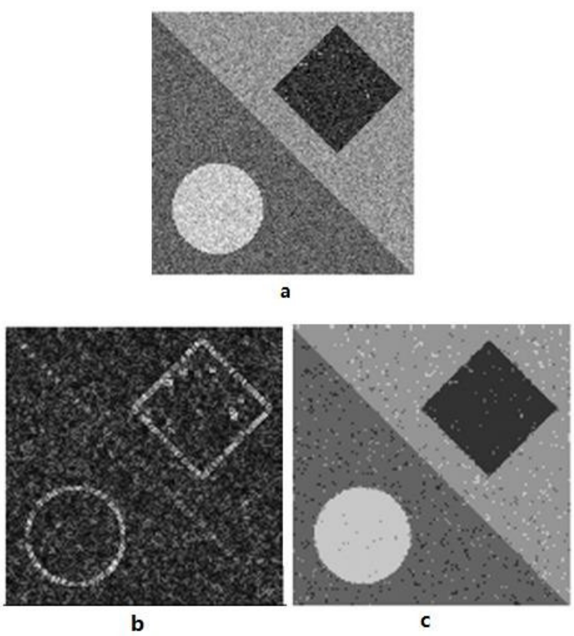
The proposed novel IT2FCM algorithm includes one important factor, this factor is composed of similarity and local spatial information, the defination of the local spatial information can be described as:

$$G_{ij} = \sum_{\substack{k\in N_j \\ k\neq j}} \frac{[(1-\widehat{u_{ik}})^m x||x_k - v_i||^2 + (s_{ik})^m]}{d_{jk}+1}$$

Where uik is the membership degree between the pixels, sik represents the similarity between the pixel and cluster center, information.

5. Experimental Results

In order to compare the rough intuitionistic type 2 fuzzy clustering algorithm with the other methods, one synthetic test image has been given in Fig.1a. From the comparison results, we can see that the proposed method is better than the other four ones but slower than the other methods.



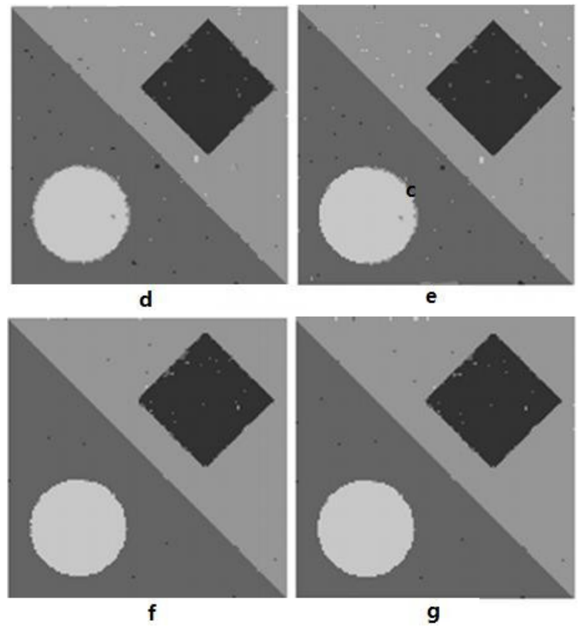


Figure 1. Comparison approaches on a synthetic image: (a) original synthetic image, (b) RIT2FCM (c) RFCM, (d) IIFCM, (e) T2FCM, (f) ASFIC, and (g) RIT2FCM

Table 1. SA values of five methods for the synthetic image

Noise levels	RFCM	IIFCM	T2FCM	ASIFC	RIT2FCM
(%)	(%)	(%)	(%)	(%)	(%)
Gaussian 5	0.05	0.03	0.02	0.02	0.02
Gaussian 10	0.31	0.02	0.22	0.22	0.21
Gaussian 20	6.18	0.85	0.73	0.64	0.62

Table 2. Average computational time for five methods

Noise levels	RFCM	IIFCM	T2FCM	ASIFC	RIT2FCM
(%)	(s)	(s)	(s)	(s)	(s)
Gaussian 5	0.4672	0.3132	2.4823	1.3463	1.3672
Gaussian 10	0.5672	0.3125	2.5371	1.6491	1.6236
Gaussian 20	0.8672	0.3835	3.5172	2.5276	2.3512

6. Conclusion

One hybrid cluster algorithm is proposed to handle the uncertaity in image segmentation, which combined the adavantages of rough sets theory, type-2 fuzzy sets theory, and intuitionistic fuzzy sets theory. From the simulation results, we can see that the proposed method could handle the randomness, vagueness, and external noises better than other methods.

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ARTICLE

Analyzing the nonlinear system by designing an optimum digital filter named Hermitian-Wiener filter

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ABSTRACT

The classical Wiener filter was engaged into identifying the linear structures, resulting in clear and incredible drawbacks in working with nonlinear integrated system. Currently, the Hermitian-Wiener system are suitable for unpredicted sub-system that consists of numerous and complex inputs. The system introduces a two-stage to analyze the subintervals where the output nonlinearities are noninvertible, through using the unknown orders and parameters. Finally, a practical strategy would be discussed to analyze the nonlinear parameters.

1. Introduction

The Hermitian-Wiener filter is mainly made of two different nonlinear subsystems that are connected in series. The original Wiener model is the basic structure of this advanced system so that it can build up and analyze the complex models, such as power amplifiers, ocean detection, advanced dynamics, and other meaningful applications [1].

The estimation of one unknown signal from another is one of the difficult problems in signal processing. In many applications, the desired signal is not available or observed directly and it would be noisy and distorted by unpredictable noise signals. In some simple environments it may design a classical filter with lowpass, high pass, or bandpass function[12].

However, the Hermitian-Wiener methods are hard to recognize the parameters than classical Wiener filters in practical application. More specifically, the complexity of Hermitian-Wiener filter has two different stages to process unknown signals. It means that the former has more processing steps to get desired signals [3].

In this paper, we apply the Hermitian-Wiener filter which is aimed to solve the nonlinear problems in nonlinear subsystems. Also, it is noticeable that the nonlinearities are not invertible in their own processing intervals. Thus, the purposes of this method expand the analyzing of frequency domain. In addition, the system can observe a series of constant signals that are estimated by controllers. In the first stage, estimate the input signals

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that will transfer to the output nonlinearity and identify the parameters of the later orders. When the linear identification is determined, the subsystem frequency benefits can be available after backlash inversion.

In the next section, the primary problems will be demonstrated. Also, the main details of the advanced methods would be given in section 2. The results of linear and nonlinear would be showed in section 3.

2. Problem Statements about Nonlinearity

The basic formula can be derived as Hermitian-Wiener model with input nonlinearity by this equation.

$$y(t)=x(t)+\delta(t)=h(w)+\delta(t)$$

$$w(t)=g(t)*v(t);where v=f(u),g(t)=L^{-1}$$

The noise $\delta(t)$ is ergodic and it is a stationary sequence with zero-mean. Particularly, the input nonlinearity is an unknown model outside the frequency intervals [4].

On the other hand, output also has nonlinearity within frequency working subintervals. Also, this property is not invertible. To be more specifically, the orders p and other parameters would change during all subintervals. The key step is to identify the accurate prediction of the nonlinear intervals and the linear frequency domain [5].

3. Working Stage of the Hermitian-Wiener filter

3.1 For the First Experiment

I derived the Weiner-Hopff equations used for calculating the FIR Weiner filter coefficients w based on the formula.

$$Rv_2w=rv_1v_2$$

This formula is the equation in its current form useful for calculating the Weiner Filter. Also, it turns out that the RHS of the above equation is rxv_2.

$$x(n)=d(n)+v_1(n)$$

$$v_1(n)=0.7v_1(n-1)+g(n)$$

$$v_2(n)=-0.5v_2(n-1)+g(n)$$

In Matlab, we generated 500 samples of the desired signal $d(n)$ (for φ use the random phase distributed between $[-\pi\ \pi]$) and generate by filtering $g(n)$ with filter parameters $a_1= 0.7$ and $a_2= -0.5$, respectively. Also, we generated the AR processes $v_1(n)$ and $v_2(n)$ and the sequence $x(n)$ from $d(n)$ and $v_1(n)$. Then, we generate the correlation matrix Rv_2 from $v_2(n)$ use the covar.m Matlab function. Next, we generate the vector rxv_2 from $x(n)$ and $v_2(n)$ using the Matlab built-in function xcorr.m by the unbiased version of xcorr. Finally, we solved the linear equations in Matlab to calculate the coefficient vector w, for the FIR Weiner filter of orders $p = 4, 10, 12$ [6].

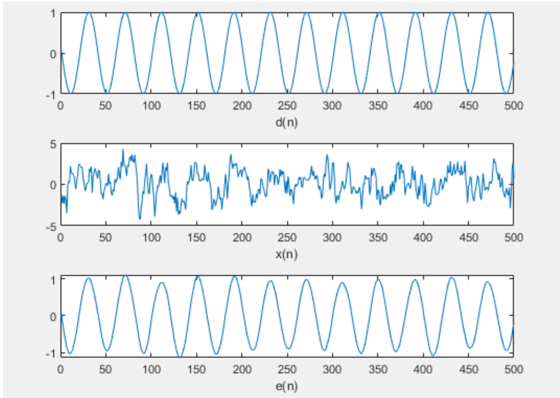

Figure 1. FIR Weiner Filter Matlab Results

3.2 For the Second Experiment

I found the autocorrelation sequence rd(k) of d(n) and then plot the power spectrum (PSD) of d(n) from rd(k). Also, I used PSD = fft (xcorr(d(n),'unbiased'), 1024).

In addition, I plot the magnitude of the frequency response of this Wiener filter. Also, comparing the frequency response with the power spectrum of d(n) and comment on the relation between the two frequency responses based on using 'freqz' to find the magnitude spectrum from filter coefficients[7].

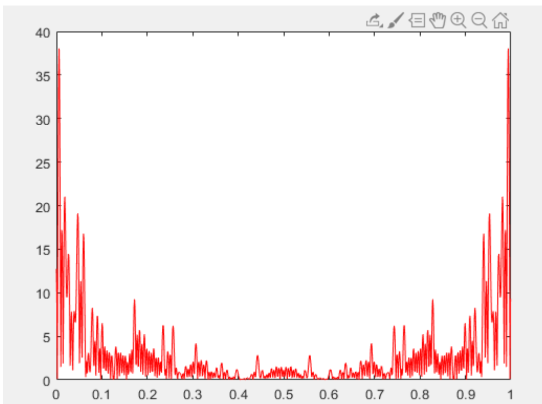

Figure 2. FIR Weiner filter Frequency responses

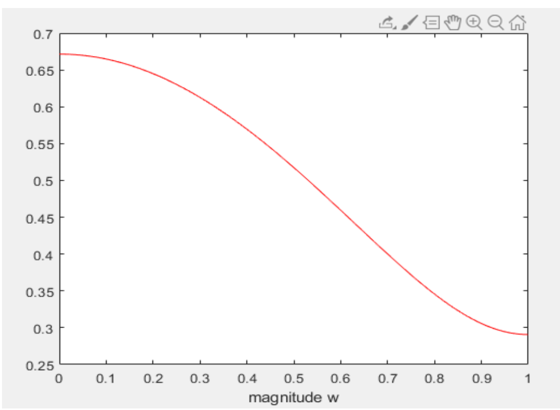

Figure 3. FIR Weiner filter Magnitude

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It can be seen from the experimental results that the upline cut-off frequency and downlink cut-off frequency of the filter are about 0.2 and 0.8 respectively. When the frequency response is 0.2-0.8, the filter is in a normal filtering state with strong anti-interference ability and noise reduction ability, and the power spectrum conforms to the working state of the filter. When the frequency response is 0-0.2 and 0.8-1, the filter is in a divergent state with too much interference and noise and weak anti-interference and noise reduction ability, which conforms to the experimental results of power spectrum.

4. Analyzing Linear system

The problem of analyzing the linear subsystem is identify the specific details of subintervals. First of all, an ideal controller is designed that focus on compensating for input nonlinearity. This system is utilized to transformed to deal with the unpredictable internal signals $v(t)$ and $w(t)$.

According to this point, the nonlinearity of input and output are unpredictable, the system can just estimate this changeable property. It is simple for users to assume that the estimated points have been determined.

However, if we know the input nonlinearity is polynomial function, introduce a controller to monitor the input of the system, which would result in the inverse at the system output. And theoretically, the outcome of the system would be equivalent to a linear subsystem with transfer function, where the frequency analyzing method is a better way to identify the parameters for continues processing[8].

5. Conclusion

Wiener filter has the advantages of a wide range of adaptability. It can be applied whether stationary random process is continuous or discrete, scalar or vector. The experimental results show that the waveform is stable, the predicted value fluctuates great and the error value is large. Therefore, the disadvantage of wiener filter is that it is difficult to meet the requirement of obtaining all the observed data, and it cannot be used in the case of non-stationary random processes with noise, and it is not convenient to apply it in the case of vector. In addition, the use of a linear shift-invariant Wiener filter will not be optimum. In the future, we will use adaptive Wiener filter to get ideal waveform

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- Other financial relationships/support
- Informed Consent

This section confirms that written consent was obtained from all participants prior to the study.

- Ethical Approval

Eg. The paper received the ethical approval of XXX Ethics Committee.

- Trial Registration

Eg. Name of Trial Registry: Trial Registration Number

- Contributorship

The role(s) that each author undertook should be reflected in this section. This section affirms that each credited author has had a significant contribution to the article.

1. Main Manuscript
2. Reference List
3. Supplementary Data/Information

Supplementary figures, small tables, text etc.

As supplementary data/information is not copyedited/proofread, kindly ensure that the section is free from errors, and is presented clearly.

Ⅲ. Abstract

A general introduction to the research topic of the paper should be provided, along with a brief summary of its main results and implications. Kindly ensure the abstract is self-contained and remains readable to a wider audience. The abstract should also be kept to a maximum of 200 words.

Authors should also include 5-8 keywords after the abstract, separated by a semi-colon, avoiding the words already used in the title of the article.

Abstract and keywords should be reflected as font size 14.

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The title should not exceed 50 words. Authors are encouraged to keep their titles succinct and relevant.

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Ⅳ. Section Headings

Section headings, sub-headings, and sub-subheadings should be differentiated by font size.

Section Headings: Font size 22, bold type

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Main Manuscript Outline

Ⅴ. Introduction

The introduction should highlight the significance of the research conducted, in particular, in relation to current state of research in the field. A clear research objective should be conveyed within a single sentence.

Ⅵ. Methodology/Methods

In this section, the methods used to obtain the results in the paper should be clearly elucidated. This allows readers to be able to replicate the study in the future. Authors should ensure that any references made to other research or experiments should be clearly cited.

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In this section, the results of experiments conducted should be detailed. The results should not be discussed at length in this section. Alternatively, Results and Discussion can also be combined to a single section.

Ⅷ. Discussion

In this section, the results of the experiments conducted can be discussed in detail. Authors should discuss the direct and indirect implications of their findings, and also discuss if the results obtain reflect the current state of research in the field. Applications for the research should be discussed in this section. Suggestions for future research can also be discussed in this section.

Ⅸ. Conclusion

This section offers closure for the paper. An effective conclusion will need to sum up the principal findings of the papers, and its implications for further research.

Ⅹ. References

References should be included as a separate page from the main manuscript. For parts of the manuscript that have referenced a particular source, a superscript (ie. [x]) should be included next to the referenced text.
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Ⅺ. Glossary of Publication Type

J = Journal/Magazine

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C = (Article) Collection

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Kindly note that the order of appearance of the referenced source should follow its order of appearance in the main manuscript.

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Ⅻ. Others

Conflicts of interest, acknowledgements, and publication ethics should also be declared in the final version of the manuscript. Instructions have been provided as its counterpart under Cover Letter.

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