Appendixes

Overlap of Problem-Solution patterns with Swales' model

pattern stage	text	move type	step
problem	Although ABC shows a powerful ability in search and exploration, the experimental results demonstrate that it still has a drawback of slow convergence speed [11].	2	Indicating a gap
solution	For enhancing the performance of the original ABC algorithm and applying it to solve real world problems, this paper proposes two alternative updating equations which are commonly used in the ABC variants to accelerate ABC's convergence rate on the condition of guaranteeing its global search ability.	3	Announcing present research
problem	Nevertheless, initial deployment of these UAV networks is not sufficient to provide efficient coverage. The users' mobility causes non-uniform densities at various locations at different instants, creating overloaded hotspot cells, called hot zones.	2	Indicating a gap
solution	An initial deployment for an efficient layout of UAV positions is presented here. The paper then highlights the effect of user mobility and irregular density (causing hot zones), in disabling the affected UAVs to serve all of their respective users.	3	Announcing present research
	Methods based on dynamical systems theory have been proposed [3],	1	
problem	but they ask for more thorough insight	2	Indicating a gap
solution	which is provided in this paper.	3	Announcing present research
	There have been efforts to implement some new and specific algorithms in hardware,	1	
problem	but some classical algorithms have been neglected as their applicability to condition monitoring was not acknowledged. Implementations so far, as in general case of condition monitoring as well, have been focused on machine learning [4],	2	Indicating a gap

solution	while the work presented here will focus on a signal processing technique from the dynamical systems theory.	3	Announcing present research
problem	The H.264/AVC FHD video decoding process still remains a challenging task for current multicore processor architectures, especially in situations where the processor needs to provide real time performance with low cost implementations [1,2].	2	Indicating a gap
solution	In this paper, an optimization procedure is presented for FHD video decoding using group of pictures (GOP) level parallelism on multicore architecture. The strategy of implementing the real-time FHD decoding is to support video playback devices such as VLC player, media player and real-time FHD video conferencing.	3	Announcing present research
	Volt/var control has been applied in support of voltage control [18,19];	1	
problem	however, to date, volt/var methods have not taken into account the voltage deviations that result from the power output fluctuations of RESs.	2	Indicating a gap
solution	In this paper, we propose a reactive power control method that reduces the voltage deviations caused by fluctuations in RES output. A conventional volt/var control method is used in tandem with the proposed method to reduce voltage deviations caused by other factors.	3	Announcing present research
problem	However, a disadvantage of this control scheme is that the value of fuzzy output is commonly obtained by 49 fuzzy rules, as proposed in [13]. This requires a high-speed microprocessor to obtain good results and makes it an expensive solution.	2	Indicating a gap
solution	To avoid this problem, a fuzzy logic controller based on only four linguistic rules is proposed in this paper. The robustness of the proposed controller to motor parameter variations is verified. The schematic diagram of an indirect field-oriented control (IFOC) drive for DSIM using conventional PI and fuzzy logic controllers is shown in Fig. 1.	3	Announcing present research
problem	However, the need of the hour is to utilize IPv6 to interface and guarantee coordinated effort between billions of SOs, as there are no newer IPv4 addresses and much reuse of the existing addresses is not a viable option.	2	Indicating a gap

solution	In this paper, we propose a model for device level IoT applications interoperability using IPv6. In particular, we focus on discovery/monitoring, syndication, and control for heterogeneous constrained environments. Our contributions include testing the proposed model on heterogeneous constrained SOs and comparing the round trip time with existing SOAP and HTTP based approaches.	3	Announcing present research
problem	Moreover, if the nature of language is taken into account and the way in which people develop words and short hand notations as new technology comes around (Google is not an English word, but is now used as a verb "let me Google that"), it becomes very difficult to design a system that can consistently detect a user's emotional state based on language alone [4].	2	Indicating a gap
solution	This paper proposes to recognize the emotional state of a user by exploiting the various built-in sensors in a mobile phone. This is achieved by creating a soft-keyboard that uses sensor data to eventually determine a user's current emotion.	3	Announcing present research
problem	Although the serial computation method for solving linear algebraic equations is mature, the serial algorithm cannot be directly used for parallel computation. Therefore, parallelism is a key factor when selecting an algorithm for a GPU.	2	Indicating a gap
solution	As current solvers based on heterogeneous systems cannot consider efficiency and stability when solving a large-scale tridiagonal matrix, this paper proposes a strong, comprehensively performing tridiagonal 2 solver combined central processing unit with graphics processing unit (T-SCG) solver that integrates a SPIKE framework, a simplified SPIKE algorithm, and a diagonal-pivot algorithm to ensure numerical stability.	3	Announcing present research

The corpus

Article 1:

Accurate fault location algorithm for shunt-compensated double circuit transmission lines using single end data

International Journal of Electrical Power & Energy Systems, Volume 116, March 2020

In recent years, there has been an effective effort to increase the SVC application in the high-voltage transmission lines [1]. Use of SVC has been an effective solution for controlling the voltage profile because of its fast response reactive power support during normal and faulty conditions [2]. The Thyristor Switched Capacitor (TSC) and the Thyristor Controlled Reactor (TCR) are used to control under-voltage and over-voltage, respectively while SVC has the combination of both. Moreover, the SVC has fast dynamic response and when it is included in the fault loop, leading to mal-operation of impedance based relaying devices. When the fault occurs in the transmission line, SVC injects a reactive current to control under-voltage of the transmission system and that cause false calculating of the fault location. So far, several studies have been performed for finding the impacts of the SVC on distance relay characteristics. In [3], authors shown that during the unsymmetrical fault, SVC would compensate all the three phase equally which leads to the incorrect phase selection and may cause to failure of single pole tripping. Obtained results in [4] indicate that impact of SVC is more for single phase-to-ground faults. Authors of [5], [6] presented a fault detection and classification scheme for SVC compensated line. In the proposed pilot relaying scheme, voltage and current at both the ends have been measured and therefore, a reliable communication channel is required to exchange the data from one end to the another end. In [7], the fundamental component of voltage and current phasors of mid-point connected SVC location are synchronously transmitted to the local terminal. In addition, high-speed optical fiber data communication is considered for data communication. A recursive simulation based distance protection scheme for SVC compensated line is discussed in [8]. However, fault location problem is not addressed. Accurate fault location schemes for the SVC compensated transmission lines are proposed in few articles such as [9]. Three steps optimization technique for fault location algorithm is proposed in [9], where knowledge of fault type and synchronous data from both ends of transmission line are required.

On the other hand, fault resistance is a critical variable in fault location estimation. Distance relays calculates the impedance between the fault and relay location. The fault resistance presents an error in the fault distance estimate and can make mal-operation of a distance relay [10], [11], [12], [13], [14].

In this paper, the negative-sequence based fault location technique for SVC compensated double-circuit transmission lines have been proposed. In this method, only the magnitudes of current signals are measured at the relay location, which means that data synchronization is not required. On the other hand, local measurement is used in the presented method and therefore, a reliable communication channel is not required to exchange the data from SVC and receiving end to the relay location. The distributed parameters model of the transmission lines is used to obtain the accurate fault location. The results of the modeling show that for all types of unbalanced faults with high fault resistance and in the presence of SVC, the accuracy of the presented method is high and its error rate is below 0.14%. To investigate the accuracy of the presented method, it is assumed that the available SVC and sources impedances simultaneously are given with 10% deviation from their actual values. Achieved results indicate that the errors still fall in an appropriate reach with a maximum error of 2.36%.

This paper is presented as follows: Section 2 reviews the background and problem definition of the conventional fault location technique. Section 3 describes the procedure of the presented fault location scheme. The simulation results for different fault cases are presented in Section 4. Accuracy evaluation is described in Section 5. Finally, conclusions are drawn in Section 6.

Article 2:

Calculation of stray losses in continuously transposed conductor cable transformer windings by multi-slice methodology

International Journal of Electrical Power & Energy Systems, Volume 111, October 2019

The reliability of an electric power system as a whole is strongly influenced by its power transformer condition monitoring. The winding temperature is a prime concern and a variable that needs to be known under all working conditions. The hottest areas of the winding, also called hot spots [1], are a real limiting factor and are particularly critical on insulated material as they make the transformer susceptible to failure.

Modeling tools are available to calculate detailed cooling flow and temperature distributions [2]. However, according to the authors' own practical experience [3] the first critical step prior to performing winding temperature calculation is to accurately determine the amplitude and concentration area of stray losses (eddy currents and circulating current losses).

Research has dealt with issues regarding transformer winding stray losses since the 1950s [4] and still continues to do so [5]. Conventionally, the stray losses reduction technique has been carried out by transposed individual conductors during the winding operation [6]. Nowadays, those tailor-made transpositions are avoided by using continuously transposed conductor (CTC) cables in power transformer windings [7] and Roebel bar [8] in high temperature superconducting (HTS) transformers [9]. Both CTC and Roebel bar share the same philosophy of geometry from a topological point of view [10].

Any attempt to model the stray losses in CTC cable (or Roebel bar) windings must consider the 3D leakage flux impact on each of their individual conductors. Although there are commercial 3D software packages, this still demands extensive time and effort for modeling and solving stray losses in CTC cables at a scale that can respond to the market. That is what has motivated this paper, which contributes by proposing a methodology based on multi-slice 2D FEM approach (a pseudo-3D) as an alternative to computing the effect of leakage flux on losses in CTC cables. Particular attention is paid to the capability for assessing the local loss concentration and current distribution in each individual conductor cross-section of CTC cable around the turns. This is of great practical importance for transformer monitoring since the overheated strand conductors are not always easy to localize experimentally, and the stray current losses cannot be measured directly.

Article 3:

Evaluating the overvoltage performance of an overhead line taking into account the frequency-dependence of its tower's grounding electrodes with high soil resistivity

International Journal of Electrical Power & Energy Systems, Volume 116, March 2020

OPERATIONNAL performance of overhead transmission lines is largely influenced by lightning activity.

Overhead line faults due to lightning can be caused by the overvoltages induced in one of the following cases: a direct lightning stroke to one or more phase conductors, a lightning stroke to the tower or to the shielding wire followed by a back flashover or due to the electromagnetic coupling in case of a lightning stroke to the ground next to the overhead line [1].

The methods which significantly influence overvoltage performance of overhead lines are: improvement of tower grounding system, increase of critical flashover voltage (CFO), LSAs' application and shielding wire application [2].

The application of a shield wire, which intercepts lightning strokes so that they cannot strike directly the phase conductors, is the common standard protection of overhead transmission lines. However, its installation to the already

existing line requires extensive modification of more than one tower of the line. Low tower grounding impedance decreases the probability of the back flashover occurrence to the overhead line tower. In some specific overhead lines' environments, such as areas with high specific soil resistivity, it is complex to reduce the tower grounding impedance. Therefore, due to their low cost and simple installation, there is an increasing number of LSAs' applications to the overhead lines to improve their lightning performance. The main constraints when installing LSAs are often mechanical and the ones related to the difficult accessibility of the overhead line towers.

Electromagnetic transient simulations are performed in order to evaluate the effectiveness of different solutions, which aim to improve the lightning performance of the overhead line. The high-frequency transient behaviour of tower grounding electrodes is a key element when conducting this type of study, therefore, it is important to apply adequate methods during tower grounding measurement, in order to have an accurate tower grounding model.

The high-frequency transient behaviour of grounding electrodes has been investigated and formulas for modelling the grounding have been proposed in [3], [4], [5], [6]. In this paper, in order to examine the impact of the tower grounding electrodes modelling on lightning overvoltages, electromagnetic transient calculations were conducted on three different cases: constant grounding impedance of the tower hit by the lightning stroke, frequency-dependent tower grounding impedance and frequency-dependent tower grounding impedance for the tower equipped with LSA installed at the lowest phase.

In the second paragraph of the paper, tower grounding impedance measurements are presented. Both, low and high frequency grounding impedance measurements, are described. In the third paragraph, the results of the computer simulation of the overvoltages due to a lightning strike to the overhead line are presented. The importance of the utilization of an adequate tower grounding model is emphasized. Finally, the fourth chapter presents conclusions and recommendations.

Article 4:

Influence of freezing water conductivity on the positive corona performance of soft rime ice-covered conductor

International Journal of Electrical Power & Energy Systems, Volume 112, November 2019

Corona performance of high voltage transmission lines, including corona loss (CL), radio interference (RI) and audible noise (AN), is strongly affected by weather conditions. As a general rule, precipitation in the form of rain, snow or sleet increases the corona activity by one or two orders of magnitude [1]. Compared to the researches of corona performance in rain conditions [2], [3], [4], [5], the existing literature of corona performance of ice-covered or snow-covered conductor is insufficient.

Most reports of conductor corona performance in icing conditions are about AC power system [5], [6], [7], [8]. The report of Peek shows that sleet on the wires lowers the corona inception voltage and increases the corona loss [5]. In [6], research result indicates that the corona loss of stranded conductor is remarkable when subjected to hoar frost, and it is very sensitive to icing thickness. The corona inception voltage and corona loss of ice-covered conductor are studied by Yin [7]. Results indicate that both the glaze ice and rime ice lower the corona inception voltage and increase the corona loss, and the effect of glaze ice is stronger. Besides, long term statistical result of the Apple Grove 750 kV Test Project [8] shows that the audible noise during a light frost or snow is about 1dBA bigger than that of fair weather conditions.

Corona inception voltage is a traditional but important topic in the research of corona phenomenon. Whereas, there is still no practical, impersonal and unified corona inception criterion. The traditional visual method is limited by natural light and observer, the visual corona inception voltage is higher than the actual value even with light amplification devices [1]. Peek [5] find that the corona losses above the knee of the corona loss versus applied voltage curve follow a quadratic law, and consequently the corona inception voltage is calculated by ΣΔ method. With the rise of ultraviolet (UV) detecting technology in the electrical industry, UV image ratio method [9] and UV photon tangent method [10] are developed to evaluate the corona inception voltage of rod-plane and coaxial configuration, respectively. The corona inception voltage of clean conductor is evaluated by UV imager, partial discharge detector, RI receiver and sound level meter, respectively [11], and the maximum deviation of the resulted four corona inception voltages is only 2.5%.

In terms of the influence of freezing water conductivity on conductor icing, the published results are either vague or controversial. The research of C. Luan Phan [12] shows that the rime ice density increases with the applied water conductivity, and this trend is more outstanding in the presence of an electric field. However, it is reported in [13] that conductivity has no impact on rime form or corona inception voltage when the conductor is energized with alternative voltage. In addition, the study of [14] indicates that freezing water conductivity has little effect on the corona loss for rime ice-covered conductor, and it has moderate influence in the case of glaze ice.

It can be inferred from the existing literature that the precipitation in the form of soft rime ice could deteriorate the conductor corona performance. In addition, the study of positive polarity corona performance is of significance in the case of the ice-covered conductor based on the author's previous research [15]. Therefore, in this research, the impact of freezing water conductivity on the positive corona performance (corona loss and audible noise) of soft rime ice-covered conductor is studied. The icing morphology and corona development process of soft rime ice-covered conductor are also discussed. Besides, comparison and recommendation of three different corona inception criteria are made.

Article 5:

Prediction of high-voltage asynchronous machines stators insulation status applying law on increasing probability

International Journal of Electrical Power & Energy Systems, Volume 116, March 2020

Spreading of fabrication, transmission and spending of electric energy power produces a need for the growth of electric machines power upon active material scale. Thereby one shall be careful to prevent that the load growth decreases the reliability of electrical machines operation. In the case of high voltage asynchronous machines, it means that special caution is observed on the stator insulation reliability [1], [2], [3]. The stator insulation reliability means a possibility that a breakdown may be predicted and overhauling is timely. The law on increasing probability may present a good service for this nomination.

The law on increasing probability provides prediction behavior of the entire insulation system [4], [5], [6]. In fact, the spreading of electrical discharge in the insulation structure is a stochastic phenomenon, described by certain statistic relevant random variable specimen distribution. And yet, if the insulation structures are massive and if the voltage sources are with enough power (as by high voltage asynchronous machine stator insulation), electrical discharge, which may start the breakdown, may arise in parallel both in space and in time. The spot, in which the electric

discharge arises most rapidly, will become in a random manner the breakdown place for the whole insulation structure [7], [8].

The purpose of this paper is to provide the method, founded on the law on increasing probability, which makes a prediction of the high-voltage asynchronous machines stator insulation status simple and efficient.

Article 6:

An efficiency experimented wind turbine emulator linked to transmission line model 380 kV

Electrical engineering, Volume 100, March 2018

The idea of power systems generation has derived from isolated generators feeding their own load to huge interconnected systems spanning entire countries [1,2,18,19]. The power transmission can be realized through overhead lines or underground cables lines [3–5]. Throughout Europe, the expansion of EHV transmission networks is being largely checked by strong public opposition to the construction of new overhead lines (OHL), such difficulties being often compounded by infrastructural congestion [3]. The cable lines together with mixed ones can lessen sensibly many route problems by virtue of their adaptability in the territory and have become a recurring topic in the technical literature [6,7]. Due to their physical extension, transmission lines are frequently exposed to the most adverse environmental conditions, leading to the largest percentage rate of faults among power system components. Many works can be used as guide to choose the shunt compensation degree to limit the over voltages in case of line energization, the charging current could be minimized by installing inductive shunt compensation at intermediate locations along the line [4–7]. The power transmission capacity of the cable depends on the load; it is optimized when these reactive outputs are equal [3]. The analysis of over voltages in distribution networks is of high importance since they may damage the power system infrastructure and the customer electrical equipment [11]. To generate the sending power, different sources are used in particularly those that approve the renewable energy applications such as photovoltaic and generators associated to wind turbines. Thus, in the technical context, to generate the power in the wind systems, different types of electric generators are associated with wind turbines, such as squirrel-cage induction generator [12,19], doubly fed induction generator [13,14], permanent magnet synchronous generator [15,16], and synchronous generator with external field excitation[17].

In this paper, an experimental wind turbine emulator linked to a transmission line model 380 kV is studied and analyzed. Firstly, a theoretical study dealing with the model of the salient synchronous generator and the transmission line, the Ferranti effect and the power analysis is presented. In the second part, the experimental results deals with the voltages, the Ferranti effect, the active and the reactive powers at the sending end and the receiving end with different kinds of loads are presented and analyzed. The loads considered in this are: pure ohmic load, pure inductive load, pure capacitive load and mixed resistive–inductive load.

Article 7:

Comparative analysis of single-phase self-excited induction generators of various rotor cages

Electrical engineering, Volume 101, September 2019

For production of low-power single-phase electrical energy, self-excited induction generators (SP-SEIGs) driven by a micro-hydro or micro-wind turbine may be applied. Usually, for single-phase power generation as an auxiliary energy

source at household, single phase of two separate stator windings' induction machines of power up to 3 kW will be sufficient operating as an autonomous single-phase self-excited induction generator [1–6]. When larger electrical power is needed, a three-phase stator winding self-excited induction generator with single-phase output should be employed for feeding single-phase loads [7–9]. Theoretically, any induction machine designed for motor operation may be directly utilized as induction generator, but its performance will be not satisfactory since, for example, problems with self-excitation of the generator may be occurred and terminal voltage regulation as well as the maximum output power at desired speed of rotation will be not sufficient. To obtain satisfactory performance of the induction generator, some reconstruction of stator windings [3, 5], rotor cage and magnetic core are necessary to improve the performance characteristics of the generator. Multiple papers have been reported on the use of copper squirrel rotor cage in induction motors [10–12], but only a few dealt with induction machines operating as self-excited induction generators [13, 14]. Boglietti et al. [10] compared three-phase induction motors with aluminium and copper rotor cage in terms of efficiency. The presented results show that the replacement of the aluminium cage by copper one increases the motor's rated efficiency, while the influence on motor currents and torque was not significant. The paper [11] presents the construction details of welded and die-cast rotor cages made of aluminium and copper and compares four designs in terms of efficiency and manufacturing costs. The authors in [12] presented the comparison of performance characteristics of induction motors with aluminium and copper rotor cages as well as for a double-cage copper rotor. Application of the copper cage resulted in increasing motor efficiency and the starting torque. The paper [13] presented a qualitative performance analysis of aluminium and copper rotor three-phase self-excited induction generator and was mostly devoted to circuit modelling. The dq model of an induction generator was expanded to include skin effect and temperature. The investigations showed that the voltage build-up time in the case of copper rotor is longer when compared with the aluminium rotor machine. Tudorache et al. [14] compared a three-phase induction machine with aluminium and copper cages, operating as motor and generator. Application of a copper cage resulted in increase in efficiency by 2.3% for motoring mode and by 1.8% for generator operation. Lowering of staring torque for motor was compensated by redesign of rotor slot shape and application of double-cage rotor.

The paper presents the qualitative investigation on utilizing copper as conductive material in rotor squirrel cage (i.e. for bars and rings) of single-phase self-excited induction generators instead of aluminium which is commonly used in general-purpose single-phase capacitor induction motors. Taking into account previously conducted study by the authors in [4], only three shapes of rotor bars, i.e. rounded trapezoidal, rectangular and round, have been considered in this paper for two different conductive materials.

Article 8:

Current density in two parallel cylindrical conductors and their inductance

Electrical engineering, Volume 99, June 2017

Two parallel, infinitely long conductors of circular cross section are, after two coaxial conductors, the simplest case of a two-conductor line (hereafter only pair or conductor pair). If the pair is supplied from a source of sinusoidal voltage, the current density is not constant on the conductor cross section, which affects the impedance of the line and thus also the inductance of the pair. The position of the pair cross section in the plane of the co-ordinates xy and the quantities that determine the pair are given in Fig. 1. The conductors are parallel to the axis z of the co-ordinates. In [1], a general method for the calculation of current density in a pair of conductors of arbitrary cross section was proposed. This method was applied to the pair under consideration. By means of current density, the impedance and inductance of a pair of conductors can be established.

The frequency f of the voltage source is assumed to be in the interval from zero to 1 MHz and thus the displacement current can be neglected [2]. Underlined symbols denote phasors and complex numbers.

The problem solved in the present article is to some extent related to the study of the problem of electromagnetic interference between high-voltage power lines and underground metallic pipelines [3]. When solving this problem, use is made of the concept of an ideal (superconducting) current return [4].

Article 9:

Field–circuit model of the radial active magnetic bearing system

Electrical engineering, Volume 100, December 2018

Magnetic bearings (MBs) represent an alternative support of the rotor in comparison with traditional bearings, i.e., ball or journal ones. MBs have found applications in many industrial devices, for example, in high-speed turbines, energy storage flywheels, turbomolecular pumps, turbogenerators, machine tool spindles and compressors [1–3]. The benefits of using magnetic bearings are well known [1]. Owing to the contactless operation of the rotor, the bearing provides a lack of friction, absence of lubricating substance, good vibration damping, online monitoring of the operation and reduced maintenance and operation costs.

Magnetic suspension dedicated to electric machine usually consists of two radial and one axial electromagnetic actuators and a control system. The actuator of the radial active magnetic bearing (RAMB) comprises two elements—a stator and rotor. The interaction between the stator and rotor is based on the principle of the electromagnetic interaction. The current flowing in the windings causes the pull of the movable ferromagnetic material. Unfortunately, the stable levitation of the RAMB rotor is only achievable by using position controllers.

In this paper, a field–circuit model of the RAMB system dedicated to the simulation of the transient states is described. The model is based on a set of the differential equations implemented in MATLAB/Simulink software. The main parameters of the RAMB were obtained from the magnetic field analysis. The model also includes the necessary control system with PID controllers for the rotor position and PI controllers for currents excited in windings. The presented simulation model was compared with the real object.

The aim of this paper is to present an effective and fast model of the RAMB system, which can be used to test various controllers as well as determine its parameters.

Article 10:

Operation of five-phase induction motor after loss of one phase of feeding source

Electrical engineering, Volume 99, March 2017

Considerable demands are imposed on variable-speed drives regarding reliability in certain applications. This concerns especially the applications that, due to safety issues, cannot be suddenly shut down. The drive is, therefore, required to work as long as possible with the lowest possible decrease in the output power. In this regard, the use of multi-phase machines seems advantageous as they have higher fault tolerance in comparison with classical three-phase machines. From this point of view, the loss of one or more legs of a feeding frequency converter is considered as a fault [1–3].

Multi-phase machines have also additional advantages, e.g. a lower content of higher spatial harmonics in the magnetic field along the air gap, a reduced level of noise and smaller parasitic torques [4–8]. If necessary, multi-phase machines can be designed for a lower voltage than three-phase machines of the same output [9–12].

Multi-phase machines can be connected with a feeding source in more ways than three-phase machines. The mentioned literature most often deals with the star connection [13]. Some of other possible configurations can, however, be in certain cases superior from the point of view of parasitic torques and losses. There will also be a lower decrease in output power in the case of a fault in a converter. In this paper, an analysis of fault tolerance of a five-phase induction machine is carried out.

Article 11:

An improved artificial bee colony algorithm with fast strategy, and its application

Computers & Electrical Engineering, Volume 78, September 2019

Optimization methods have attracted the attention of many researches that were conducted in the 18th century. They have now been utilized in various fields concerned with real world problems. In using these methods, evolutionary algorithms (EAs) demonstrate excellent achievements due to their easy realization and fast search ability [1]. They have been successfully applied in Pattern Recognition, and so on [2], [3], [4], [5], [6], [7], [8], [9].

As a modern EA, an artificial bee colony algorithm (ABC) was first proposed by Karaboga in 2005 [10]. Although ABC shows a powerful ability in search and exploration, the experimental results demonstrate that it still has a drawback of slow convergence speed [11]. For overcoming this problem, several works have been proposed [12], [13], [14] in recent years. The individual with the best performance is utilized by Zhu and Kwong [12] to accelerate its convergence rate. Karaboga and Gorkemli [13] propose a new definition of the best solution among the current food source's neighbors to make precise searches among onlooker bees. An updated equation employed in a differential algorithm (DE) is used in ABC by Gao and Liu in [14], which helps bees to exploit the situation around the other bees with better performance for accelerating its convergence speed. For better balancing in exploration and exploitation searches of ABC, the author proposes a new updated equation by utilizing two randomly selected bees by employing an orthogonal learning strategy in [15]. By adjusting the values of some parameters in ABC, Akay and Karaboga [16] suggest that its convergence speed is determined by the frequency of perturbation in ABC, and a larger perturbation could prevent the population from getting stuck in unimportant local situations.

For enhancing the performance of the original ABC algorithm and applying it to solve real world problems, this paper proposes two alternative updating equations which are commonly used in the ABC variants to accelerate ABC's convergence rate on the condition of guaranteeing its global search ability. Furthermore, a Cauchy mutation strategy is introduced into the two proposed updating strategies to balance their global and local searches. And finally, a robot path planning problem is employed to verify the effectiveness of our algorithm.

The paper is organized as follows. Section 2 introduces the original ABC algorithm. The two proposed updating equations and the proposed Cauchy operator are described in Section 3. In Section 4, commonly compared benchmark functions and a path planning problem are employed to show the merits of our algorithm. The conclusion of this paper is contained in Section 5.

Article 12:

Dynamic self-reconfiguration of unmanned aerial vehicles to serve overloaded hotspot cells

Computers & Electrical Engineering, Volume 75, May 2019

A prominent application of Unmanned Aerial Vehicle (UAV) networks is in providing wireless coverage to ground users. Offloading ground base stations is one of the implemented approaches to harvest the UAVs' potential in providing wireless services [2]. However, due to the impracticability of ground conditions or time constraints, these base stations cannot be established. In such scenarios, the users can be served by a swarm of UAVs that can be deployed on-the-fly [3].

In 2011, the US government considered the deployment of a drone network (as an extemporaneous communication system) in emergency situations to be promising [4]. The National Public Safety Telecommunications Council started investigating drone based communication four years later [5]. Virtual Network Communications [6], a startup, developed a scalable LTE (Long-Term Evolution) base station called a Green Cell. It contained a credit-card-size component employing LTE technology to form an ad hoc network with neighboring radios, subsequently connecting to a nationwide cellular network. This can support 128 users at a time on any LTE frequency. The Green Cell along with its battery weighed only 2 kg, light enough for a drone to carry. The authors in [7] proposed a drone-mounted base station mechanism by mounting LTE femtocells on drones to offer an alternative for the overloaded existing wireless infrastructure. The mechanism calculates the required number of drones and their optimal locations to maximize user coverage.

Nevertheless, initial deployment of these UAV networks is not sufficient to provide efficient coverage. The users' mobility causes non-uniform densities at various locations at different instants, creating overloaded hotspot cells, called hot zones. Limitations in the available UAV count, UAVs' battery life constraint, and the requirement of an uninterrupted service to users call for a judicious load distribution, and repositioning of these UAVs. When an UAV moves from its current position, some or all of its users may remain unattended until another UAV comes to serve them. These challenges overshadow the unparalleled capability of UAV networks in providing wireless coverage.

Considering the above problems, this paper's objective is to present a UAV deployment scheme to serve the maximum possible number of users by minimizing the service interruption time. An initial deployment for an efficient layout of UAV positions is presented here. The paper then highlights the effect of user mobility and irregular density (causing hot zones), in disabling the affected UAVs to serve all of their respective users. The proposed solution allows these UAVs to prudently choose their peers so that they can dynamically reposition themselves to maximize the users served. The algorithms are presented for: (1) redistributing loads (user demand) in shared areas of adjacent cells; (2) the dynamical reconfiguration of the network topology based on overloaded cells; and (3) swapping the positions of UAVs with their 1-hop neighbors.

The rest of the paper is organized as follows: Section 2 showcases recent research in this area. Section 3 explains the proposed mechanism of the initial deployment of UAVs, the three algorithms discussed before and the various assumptions that are taken. Section 4 explains the simulation environment, parameters, and results. Finally, Section 5 concludes the paper.

Article 13:

Hardware implementation of auto-mutual information function for condition monitoring

Computers & Electrical Engineering, Volume 66, February 2018

The question of motor age identification using vibration signals has been studied thoroughly in the past [1], [2]. Methods based on dynamical systems theory have been proposed [3], but they ask for more thorough insight, which is provided in this paper. This study provides an analysis of dynamical system properties of artificial motor aging vibration data, a novel method for age detection and an implementation of this method in an innovative conceptual model.

Regarding realization, the idea of condition monitoring algorithm implementation in hardware is not new [4], [5], [6]. There have been efforts to implement some new and specific algorithms in hardware, but some classical algorithms have been neglected as their applicability to condition monitoring was not acknowledged. Implementations so far, as in general case of condition monitoring as well, have been focused on machine learning [4], while the work presented here will focus on a signal processing technique from the dynamical systems theory.

In work presented here, we introduce a novel framework for condition monitoring prototyping and training, which we use as the platform for a hardware implementation of auto-mutual information function calculator. While it is usually used in dynamical systems theory for attractor reconstruction, here we show that the auto-mutual information function is a good indicator of motor state, when applied to its vibration signals.

In the second section of the paper, we present the fundamental concepts our implementation relies on: the auto-mutual information function, hardware description and the problem of the artificial motor aging. While describing the listed concepts, we also discuss the way we implement them. In the third section, we show the results of our proposed solution applied to two fundamentally different problems of condition monitoring, artificial and non-artificial motor aging. Finally, we discuss the results obtained before drawing conclusions and implications for future work.

Article 14:

Performance optimization of real-time video decoding

Computers & Electrical Engineering, Volume 70, August 2018

Nowadays, multicore architecture is widely used in the implementation of multi-tasking applications to enhance the performance. Multicore architecture provides a platform for speeding up the application by performing thread-level and data-level parallelism rather than by increasing the operating frequency of the processor. The H.264/AVC FHD video decoding process still remains a challenging task for current multicore processor architectures, especially in situations where the processor needs to provide real time performance with low cost implementations [1], [2]. Various optimum-threading methods have been proposed to speed up the performance on multi-core platform [3], [4], [5], [6]. In this paper, an optimization procedure is presented for FHD video decoding using group of pictures (GOP) level parallelism on multicore architecture. The strategy of implementing the real-time FHD decoding is to support video playback devices such as VLC player, media player and real-time FHD video conferencing. In this paper, problems such as optimum GOP size required, complexity of video decoding, and preservation of video quality are investigated. Main focus is to find the optimum number of frames to be used in each GOP for enhancing the decoding efficiency and minimizing distortion.

The remaining part of the paper is organized as follows. Section 2 presents the details of background works on decoder parallelization techniques. In Section 3, the design and implementation of GOP level parallelism using dynamic memory scheduling for FHD video decoding are explained in detail. Section 4 presents the results and discussions related to the performance in terms of speedup, visual quality, thread utilization and memory optimization for reduction of cache misses. Finally, Section 5 presents the conclusion and future work.

Article 15:

A novel network security algorithm based on improved support vector machine from smart city perspective

Computers & Electrical Engineering, Volume 65, January 2018

The fast advancement and improvement of the Internet has brought security problems to systems which is progressively becoming a extraordinary issue and has been a concentration in the ebb and flow exploration. In recent years, people pay more attention to the problem of IDS, which is closely related to the covert use of system management [3]. In any case, it is difficult to detect the assault and the typical system access. In today's IDS, large-scale information grouping and scheduling has become increasingly important and has become a test area. Albeit different apparatuses are projected, they are productive for certain applications adequately, which are used for exponential developing high dimensional information inputs [7], [9]. Intrusion detection systems are designed to protect computer systems from various digital attacks and infections [13]. The intrusion detection system constructs a robust feature model and examples to identify the general practices of system information described by nonstandard practices. Two basic hypotheses in intrusion detection are studied, for example, client and program exercises can be recognized by PC systems according to system reviewing mechanisms, and ordinary and intrusion exercises must have particular practices. The field of intrusion detection consists of two different approaches, that are abuse detection and anomaly detection [17], [18]. The basic idea of misuse of investigation is to detect the attack of a certain type or target in some way, and even identify the types of these attacks. In view of these signs, this method identifies attacks by describing the criteria for each known attack [1]. The trouble for identifying obscure assaults has become a fundamental drawback in the mark-based method. The primary objective of the anomaly detection method is to describe the typical activities of the manufacturing factual model. In this point, any deviation from this model can be viewed as an anomaly, and perceived as an assault [20]. When this approach is utilized, it can identify obscure assaults hypothetically, despite the fact happened now and again, the considered approach gives rise to high false assault rate. Given the general manufacture models in the past few years, people are keen to develop new manufacturing models [6], [10].

Anomaly detection approach is one of the extremely dynamic researches in the machine learning group, which has been the theme of presented numerous articles over many years. The best approach depends on gathering information from typical operations of the system. In view of this information portraying ordinariness, if any deviation is seen in any case, it would be considered as an anomaly [11]. A few machine learning standards include the hidden Markov model, bolster VM, fake neural system, counterfeit neural system and multivariate versatile relapse splines fluffy surmising systems, which have been researched for the outline of IDS [19]. In the manuscript, we conduct researches and assess the performance of OC-SVM. The proposed amalgam method based on decision tree learning-ID3 and OC-SVM is a combination of A-DT and SVM. Compared with the different methods, it can improve the accuracy of IDS intrusion detection system by using half method [27]. The rest of the paper is organized as the follows. In the Section 2, we review the state-of-the-art related works; in the Section 3, we introduced IEEE Transactions on Reliability; in the Section 4, we discussed the DTL-ID3; in the Section 5, we analysed the A-DT & SVM; in the Section 6, we implemented the proposed method with the experimental simulation; the Section 7 summarized the work.

Article 16:

A voltage deviation-memorizing reactive power controller for renewable energy sources

International Journal of Electrical Power & Energy Systems, Volume 107, May 2019

The use of distributed generators (DGs) has steadily increased in recent years to meet the growing demands for electrical energy, and to address environmental, social, and economic concerns. Several projects have been conducted at test-bed level, the majority of which proceeded to successful commercial application. Simultaneously, the penetration levels of renewable energy sources (RESs) have increased significantly, particularly in Northern European countries such as Sweden and Norway, where they exceeded 30% in 2012. In the United States, the installed generation capacity of photovoltaic (PV) generation systems exceeded 10 GW in 2013 [1], [2].

The large-scale penetration of DGs into distribution systems results in voltage stability problems for the grid, and the inconsistency of output power from RESs exacerbates these problems. Numerous studies [3], [4], [5], [6] have investigated power output forecasting, with the aim of developing strategies for mitigating these problems. Optimization algorithms have been proposed [7], [8], [9], [10] for optimal control of grid voltage; however, these methods neglect to consider forecasting errors, which in practice cannot be nil. Voltage deviations resulting from the output power fluctuations of RESs become particularly problematic in a real-time scale. This is because the RES power is forecasted based on a certain time interval (from tens of minutes to an hour). Within the time interval, the RES power is assumed to be constant whereas the real RES power is fluctuating in a real-time. Eventually, the optimal operating point for the system calculated by the optimization algorithms described in [7], [8], [9], [10] will deviate from the desired value. Even the use of an on-load tap changer (OLTC) cannot solve this problem, due to its relatively slow response.

To overcome the problems caused by rapid voltage fluctuations, control methodologies that use reactive power compensation, such as static VAR compensators (SVCs), have been proposed [11], [12], [13]. However, it is difficult to determine the optimal locations for reactive power compensators in distribution systems, as the environment is subject to unpredictable changes. Moreover, the installation of reactive power compensators entails additional costs and, hence, may not be economically viable.

Several voltage compensation methods that use the reactive power control of DGs have been proposed [14], [15], [16], [17]. In [14], matrix perturbation theory was used to optimize the droop coefficient, and in [15] the droop coefficient was determined using a fuzzy controller. Re-planning the voltage control reference has been suggested as a means of [15] minimizing forecasting errors; however, this would require short-term forecasting. Another potential approach is to change the droop coefficients adaptively, based on a nonlinear function of the active and reactive power outputs of the converter [16], or to use communication links [17]. However, both of these approaches consider only equal division of the reactive power, and all of these voltage compensation methods are based on voltage–reactive power (V–Q) droop control. Volt/var control has been applied in support of voltage control [18], [19]; however, to date, volt/var methods have not taken into account the voltage deviations that result from the power output fluctuations of RESs.

In this paper, we propose a reactive power control method that reduces the voltage deviations caused by fluctuations in RES output. A conventional volt/var control method is used in tandem with the proposed method to reduce voltage deviations caused by other factors. To demonstrate the efficacy of the proposed method, from the perspective of preventing deviations from an optimally scheduled operating point, the initial values of the output reactive power of the RESs in a power system were determined using particle swarm optimization (PSO).

The remainder of the paper is organized as follows: Section 2 describes the optimization algorithm that was used to determine the operating point of the RES's reactive power; Section 3 describes the proposed reactive power

controller; Section 4 details the system configuration; Section 5 discusses simulation results; and Section 6 presents our conclusions.

Article 17:

Distance protection of block transformer units

International Journal of Electrical Power & Energy Systems, Volume 102, November 2018

In this paper problems related to protection of block units are discussed, where distance relay is usually a back-up for given transformer and adjacent lines [1]. Special attention is paid to the configurations when the distance relays are installed at the triangle side of a block transformer, as shown in Fig. 1. It is usually the case that the star side signals are not available or are not used, which may be a source of impedance measurement errors and relay maloperation [2], [3]. It is even stated in [3] that the operation errors of the distance relays are unavoidable for behind located ground faults. Although the distance relay is meant as a back-up for faults along the adjacent line, its operation should be reliable and safe, which cannot be guaranteed with standard solutions and algorithms.

There exist a number of decent publications related to distance protection principle. Nevertheless, not many of them are related to block transformer or in-zone transformer applications. If any, they mostly deal with different aspects of distance protection, e.g. discussing the protection under-reach for in-zone phase shifting transformers [4] or the influence of power swings on block unit distance protection [5]. Some proposals to overcome the problems with transformer distance protection operation may be found, introducing e.g.:

-zero-sequence based compensation of the transformer tertiary winding influence (first zone is analyzed only) [6],

-employing a three-relay arrangement based on resistance elements [7],

-distance protection coordination with use of the IEC61850 GOOSE message-based scheme [8], which do not solve the basic problem of wrong impedance calculation through the transformer for behind located faults.

Since none of the abovementioned approaches is 100% efficient or the ideas described require a lot of effort and costly installations, an efficient and comprehensive approach to the problems with distance relay under-reaching for single-phase faults behind the in-zone transformer is still to be developed. In this paper the following points have been addressed. First, present solution performance for d and Y transformer side faults is investigated. Then a proposal of improvements for correction of through-transformer impedance measurement errors as well as development of settings recommendation for the new protection is discussed.

It is shown that substantial improvement of the distance protection operation may be reached with introduction of the zero-sequence current and appropriate settings of the protection algorithms.

Article 18:

Assessing the power quality of internal combustion engines operating with different fuels

Electrical engineering, Volume 99, September 2017

The quantity and quality of biogas production directly depends on the type of organic material from which it is derived, with average methane concentrations ranging from 50 to 65% volume and CO2 concentration ranging from

30 to 35% volume [11]; in addition to its content, the technology used for its production is important. [10] published a review of biogas production technology in Europe.

This article does not review the calorific power of biogas nor its production. This article focuses principally on the electrical parameters surrounding the production of electricity using biogas in the engine of a generator. Voltage, frequency, harmonic frequency, and additional qualities of the electricity that is produced are important to understand.

In this case study, we used a biogas filter that makes the biogas become "purer". We reviewed the performance and behavior of an 8500W electrical plant using two different types of fuel: gasoline and biogas. In this case study, we reviewed the effect of altitude on internal combustion engines; in this case, the 8.5kW generating plant that was studied is situated 1900m above sea level. The reduction of atmospheric pressure and temperature affects air density and composition, which has an effect on electricity conversion efficiency. This case has been reviewed by [3]. In order to have a clearer idea of the effect of altitude on internal combustion engines, we assume the motor efficiency and consequently the actual exit potential to be reduced by a rate of 1% for every hundred meters of altitude after an altitude of 300m above sea level [7].

The important contribution of this article is presented in the relevant data regarding harmonic distortion that occurs while not obtaining high-quality electricity. To this end, once we understand the data, it is possible to improve the electricity quality by applying a regulation technique with the help of power electronics.

Article 19:

Conducted electromagnetic interference: theoretical and experimental investigation

Volume 99, September 2017

Within the recent years, EMC problems became the main industrial concern. Each system emits EM signal, which has significant consequences. In fact, we can distinguish three cases. If a system affects another one, the EM signal is called emission. Otherwise, if a system is affected by another system, EM signal is called susceptibility. The third case concerns the system which affects itself.

Therefore, the prevention from those effects becomes compulsory due to the proliferation of electronic devices, (in different domain: public, industry) combined with a rapid increase in operating frequencies coupled with the reduction of the supply voltage.

This paper presents an illustration of electromagnetic compatibility problems. It is divided into three parts corresponding to three coupling modes, which are the galvanic coupling, capacitive coupling and inductive coupling. For each part of the chapter, a theoretical introduction is given and a test device illustrating the theoretical part is implemented.

Article 20:

Fuzzy logic field oriented control of double star induction motor drive

Volume 99, June 2017

Use of the double star induction motor (DSIM) drives, especially for high-power applications, has considerably increased over the past 40 years [1,11]. The principal advantages of these motors are (1) possible reduction of the torque ripple, (2) enabling filter of rotor harmonic currents thus reducing losses, (3) reduction of the harmonics content of the dc-link current and (4) increased reliability and capability of operation under one or more phases fault [1,3,8].With these advantages, the DSIMs are used in several applications, especially those requiring high power such as electric/hybrid vehicles, locomotive traction and electric ship propulsion [2,11]. The DSIM is composed of windings spatially shifted by 30 electrical degrees. These windings are generally fed by two voltage source inverters (VSIs) for variable speed operation [4,5].

In this paper, two control strategies, PI and fuzzy logic, are considered to adjust the speed of the drive system. The fuzzy logic controller (FLC) is based on the linguistic rules with an IF-THEN general structure, which is the basis of human logic [7]. Its main advantage resides in the fact that it does not require an exact mathematical model of the system, it can handle an arbitrary complex nonlinearity and moreover, it is robust. However, a disadvantage of this control scheme is that the value of fuzzy output is commonly obtained by 49 fuzzy rules, as proposed in [13]. This requires a high-speed microprocessor to obtain good results and makes it an expensive solution. To avoid this problem, a fuzzy logic controller based on only four linguistic rules is proposed in this paper. The robustness of the proposed controller to motor parameter variations is verified. The schematic diagram of an indirect field-oriented control (IFOC) drive for DSIM using conventional PI and fuzzy logic controllers is shown in Fig. 1.

This paper is organized as follows: The DSIM model is provided in Sect. 2, and the DSIM IFOC is presented in Sect. 3. Next, the proposed fuzzy logic structure is given in Sect. 4, and the results are presented and discussed in Sect. 5. Finally, conclusions are presented in Sect. 6.

Article 21:

An applications interoperability model for heterogeneous internet of things environments

Computers & Electrical Engineering, Volume 64, November 2017

The IoT is a vital idea that uses the Internet Protocol (IP) to speak with real-world, physical objects called Smart Objects (SOs). SOs combine embedded systems, ubiquitous computing, mobile telephony, telemetry, wireless sensor networks, mobile computing, and computer networking [1]. They normally contain sensor(s) and/or actuators, a microcontroller, a communication medium, and a power source. These SOs/motes are generally constrained in nature, with just a couple of kilobytes of memory, a 8-/16-/32-bit chip, a low-power source (battery) and a wireless communication device (few hundreds of kilobits per second). They likewise cost less (a couple of dollars) and have a small (a couple square mms) form factor. SOs are broadly utilized as a part of home automation, logistics, healthcare, power grids, car parking, wildlife monitoring etc.

A noteworthy worry in realizing the vision of the IoT is applications interoperability. Basically, the SOs might be heterogeneous in nature with various operating systems (sometimes without an operating system), architectures, and languages. Application(s) in such different frameworks may need to flawlessly communicate with each other, especially when these are part of a constrained environment. To the best of our insight, existing works (see Section 2) on IoT applications interoperability use medium sized SOs with ways to deal with connectivity either as being direct or through proprietary protocols inside of a Personal Area Network(PAN) increasing the overhead of the gateway. Despite the fact that these arrangements handle IoT applications interoperability, they couldn't be applied on any heterogeneous constrained situations. Also, most research (see Section 2) has concentrated on utilizing either IPv4 or

proprietary methods to network SOs. However, the need of the hour is to utilize IPv6 to interface and guarantee coordinated effort between billions of SOs, as there are no newer IPv4 addresses and much reuse of the existing addresses is not a viable option. In this paper, we propose a model for device level IoT applications interoperability using IPv6. In particular, we focus on discovery / monitoring, syndication, and control for heterogeneous constrained environments. Our contributions include testing the proposed model on heterogeneous constrained SOs and comparing the round trip time with existing SOAP and HTTP based approaches.

The rest of this paper is organized as follows. Section 2 shows a brief survey of related work and the inspiration driving this paper. Section 3 depicts our proposed REST based model and the functions of its major components. We present the evaluation method in Section 4. Section 5 has the setup and the description of the tests carried out on our proposed model. Section 6 presents the results of the tests carried out in the previous section and also compares the performance of our model with existing approaches. Section 7 concludes the paper.

Article 22:

Emotion recognition using mobile phones

Computers & Electrical Engineering, Volume 60, May 2017

WITH the advent of computing came a growing dependency on smartphones that went beyond the communication purpose they were originally intended for. People today use mobile phones to carry out a range of daily tasks like shopping, ordering food, etc. In addition, mobile phones are also being used as entertainment hubs. Over time, mobile phones have increasingly become more complex to meet consumer's demands and to satisfy an ever-growing need for more computational power. An average mobile phone now comes equipped with communication modules (Bluetooth, Wi-Fi etc.), an array of sensors (accelerometers, gyroscopes, temperature sensors etc.) and significant computational power. These built-in sensors can be used to deploy unique applications that were not possible in the past.

One area where sensors can be used is to perceive a user's emotional state [1]. By capturing a user's current emotions, a device could intelligently personalize the user's experience. Such technology could support application in many domains such as social media, healthcare, etc. Social networks, such as Facebook and Twitter, would be able to respond differently to users based on their current emotional state. This could allow social networks, for example, to block a user from accessing their services, or send them help if they were in a severely distressed state. Another application in social media can be immediate feedback. A post on twitter or Facebook can be automatically flagged if the majority of viewers responded negatively to it. Another area of application is healthcare where users can keep track of their own psychological health. The application enables them to determine, for instance, sudden shifts in mood, or changes in mental health allowing a person to seek help if needed [2]. Finally, through a web service, public users could also collect demographics about the emotional state of a populace. Not only that, but medical organizations can also infer correlations between geographical conditions, context, and psychological wellbeing of individuals in that region.

Emotion recognition on various devices typically relies heavily on user input gathered in an intrusive manner [3] such as filling in surveys and/or questionnaires, or by using language processing [4] to determine the user's mood. Filling out forms is cumbersome and, for example, not likely to happen when someone is angry. Similarly, using natural language processing for emotion detection, especially on a phone, is difficult. For example, if someone were to type “lol” or “rofl” etc., the natural language processor, unless configured to recognize these short hands, would infer, falsely, that the user made a spelling mistake. Moreover, if the nature of language is taken into account and the way

in which people develop words and short hand notations as new technology comes around (Google is not an English word, but is now used as a verb “let me Google that”), it becomes very difficult to design a system that can consistently detect a user's emotional state based on language alone [4].

This paper proposes to recognize the emotional state of a user by exploiting the various built-in sensors in a mobile phone. This is achieved by creating a soft-keyboard that uses sensor data to eventually determine a user's current emotion. This soft-keyboard replaces the default mobile phone keyboard and can be used with any application. The soft-keyboard connects to web-service that provides personalized statistics reflecting the emotional state of a user through time. Others can access the web service to view the average emotional profiles of populations across geographical locations.

The rest of the paper is organized as follows. The next section describes previous work in detecting emotions using mobile phones. Section III describes the design of the system including an evaluation of the machine learning algorithms used. Section IV shows the system architecture and implementation. Section V presents the conclusion and future work.

Article 23:

Research on tridiagonal matrix solver design based on a combination of processors

Computers & Electrical Engineering, Volume 62, August 2017

In many scientific computing and engineering applications, the final numerical calculation is summed up in the form of linear equations to solve one or more large-scale sparse matrices. Most typical is a tridiagonal matrix, which plays an important role in these applications. A tridiagonal matrix solver is used in computer graphics [1], [2], [3], fluid mechanics [2], [4], [5], Poisson solvers [6], semi-coarsening multigrids [7], [8] and atmospheric simulations [9], where the matrix scale can reach the order of millions or even higher. Past algorithms for solving linear equations are mostly executed on a serial system. However, the computations are becoming increasingly complex, and the associated matrix scale is growing. Dramatic increases in calculations and storage requirements have resulted in rapidly expanding consumption of computer resources and computing time. Consequently, solving a tridiagonal matrix based on a serial system cannot meet the demand, hence parallel devices and parallel computing are developing rapidly.

Research of graphics processing units (GPUs) provide a new idea for solving a tridiagonal matrix in parallel. Due to the limitations of GPU architecture and memory-access methods, the parallel execution of a tridiagonal matrix solver must break the inherent linear dependency of the equations. In 2011, Davidson et al. proposed a "register packing" approach that can reduce communication of shared memory [10]. Daniel Egloff proposed a parallel cyclic reduction (PCR) algorithm for solving the finite difference partial differential equation (PDE) solver [11]. Nikolai Sakharnykh proposed a thread-level parallel Thomas algorithm combined with PCR to form a PCR-pThomas algorithm, and implemented it on a GPU [12]. Although the serial computation method for solving linear algebraic equations is mature, the serial algorithm cannot be directly used for parallel computation. Therefore, parallelism is a key factor when selecting an algorithm for a GPU.

When a central processing unit (CPU) and GPU develop steadily and independently, their combination can more practically exploit their respective advantages. As current solvers based on heterogeneous systems cannot consider efficiency and stability when solving a large-scale tridiagonal matrix, this paper proposes a strong, comprehensively performing tridiagonal solver combined central processing unit with graphics processing unit (T-SCG) solver that

integrates a SPIKE2 framework, a simplified SPIKE algorithm, and a diagonal-pivot algorithm to ensure numerical stability. In addition, three optimization mechanisms are proposed for the solver's GPU component to improve its overall performance.

This paper includes five parts. The first part explains the purpose of the research. The second part introduces the structure of the GPU and typical tridiagonal solving algorithms, such as Thomas, cyclic reduction (CR), and SPIKE, laying the groundwork for the improved solver. The third part shows how the proposed T-SCG solver combines the SPIKE2 framework with the simplified SPIKE algorithm. The fourth part covers the optimization of the T-SCG solver with three different methods. The last part outlines the experiments used to prove the performance of the T-SCG solver.