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Editorial

Sensors, Signal, and Artificial Intelligent Processing

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Sensors and signal processing are fully applied in modern industry. However, with the rapid expanding of sensing applications, this requires sensors with multifunctionality, intelligence, and quick response of decision. Thus, they have substantially conducted things in both complexity and sophistication to procure a technically and economically key parts in current works. Sensors are functional infrastructure that convert physical variables into digitally meaningful signals. However, this is crucial since sensors can have extra functionalities which consist of low power, multimodality, high-speed processing, physically small, and intelligence. On the other hand, signals from multiple sensors can be integrated and combined to make decisions for solving specific problems. This consists of several examples such as building electromagnetic sensors for nondestructive testing to automatically detect cracks, corrosion, debonding and etc.; hybrid of infrared and vibration sensors for monitoring of mechanical failure is investigated. In particular, multiple functionality sensing structure is integrated in many applications such as the hot topic in unmanned vehicle. Simulation work of sensing in multiphysics is starting to be very attractive to researchers. All the above contents have confirmed that sensor intelligence, multiphysics, and multifunctionality presents a significant role in modern engineering.

Sensors, Signal, and Artificial Intelligent Processing (SSAIP) crosses the boundary of multidisciplinary research concentrating on the physics-mathematical foundation and practical applications of sensors, sensing principle signal processing, and machine learning algorithms that enable a system to intelligently learn, reason, and process. This topic bridges the gap between theory and application, generating novel sensing methodologies for both longstanding and emergent industry applications. The core of SSAIP targets the physical mechanism in sensors, signal processing, sensing machine learning/deep learning, and sensor integration. SSAIP introduces a new theoretical framework that enables interpretation of sensing using physics-based statistical signal processing. In addition, novel developments of a variety sensors that integrate the processing of signals including audio, chemical, biosignals, electromagnetic, thermography, multiphysics signals, images, multispectral, and video can be expected from this framework. More form of intelligence learning algorithms will be involved into sensor framework to augment extra solving ability. These algorithms have the capacity to generalize and discover knowledge for themselves. In particular, it is capable of learning new information whenever unseen sensor signal is captured. This *Special Issue* includes more than twenty works focused on sensor signal and information processing based on diverse technologies for different applications.

1. Wireless Sensor Network

Wireless sensor network-based research has attracted in plenty of applications. In the application of wireless power transmission, the main impact factors include inductance and quality factors. These factors will affect the transmission efficiency. Once the requirement of high-power wireless charging is acquired, ferrite bricks can be selected to increase the self-inductance of the coils as well as transmission efficiency. Y. Zhu et al. [1] have investigated several effects on wireless transmission in real applications. Both theoretical and simulation have been conducted, and the wireless transmission system has been generated. In addition, both obtained high power and efficiency transmission for EVs. On the other side, the water pollution attracted the researchers to build sensor networks in optimizing water quality monitoring by developing new underwater sensor coverage technique. Since sensor network exists limitation within the monitoring range, 3D target coverage of heterogeneous is required to be optimized since multisensors are essential for fusion. To achieve this goal, in [2], a chaotic parallel fish swarm algorithm has been proposed. The chaotic selection with the combination of the global search capabilities has been applied. The diagnosis is a key technique to ensure the reliability for wireless sensor networks. In [3], the fault diagnosis of sensor nodes in WSN has been proposed where kernel lined learning machine is proposed. This method can be optimized by artificial bee colony algorithm in which it can solve regression issues.

In addition, intelligent transportation WSN takes important role. This method deploys remote sensing sensor nodes within high yield and low energy consumption for complex traffic parameter coordination. Z. Zha et al. [4] have proposed a modified clone genetic algorithm with adaptive ability to solve task allocation in ITWSNs. It employs operator of clonal expansion to speed up the convergence rat, while adaptive operator is updated to improve the global search capability. In particular of industrial WSN, it usually uses a huge number of sensors for monitoring. This costs redundant nodes. Y. Liu et al. [5] have proposed a quantum clone grey wolf optimization method to improve the usage of IWSNs. It combines the idea of quantum computing as well as the clone operation.

Notwithstanding the above, environmental monitoring is important, and it is used to monitor temperature and oxygen. B. Liu et al. [6] have proposed a chaotic based evolutionary algorithm for clustering of the low power in environmental monitoring. Through simulation experiments, this improved node energy usage efficiency. J. Xiao et al. [7] have designed an optimization algorithm with adaptive whale strategy which decreases the energy consumption with QoS. The simulation results suggest that the CAWOA-based routing algorithm got better performance in terms of routing energy consumption, convergence speed, and optimization ability. Another hot research field is passive target sensing in wireless case. In [8], a passive moving target localization system in single access point is proposed. The multiple antenna access point has been generated to form an antenna array where its localization can reach 1.087 m.

Thanks to wireless communication capability added to the sensors, another advanced sensing technology emerged and became popular in numerous manufactures and institutions for SHM applications, that is, RFID sensors [9]. Among the different types of RFID sensors available, passive sensors are the one that received a lot of attention in health monitoring area due to the fact that they have the potential to offer various advantages from low-cost solution and battery-less to long lifetime system perspective [9–13]. The most common RFID based sensors developed for SHM applications are given in [14]. Although wireless technologies offer many advantages, there are still some limitations that remain to be solved, such as power consumption, bandwidth constraints, transmission range, and possible security issues. Over the last two decades, numerous WSN-based SHM systems have been proposed in the literature. Current development of WSN for SHM systems proposed in the literature is summarized in [14–19].

2. Multimodality Sensing in Nondestructive Testing

Multimodality sensing techniques have been proposed in nondestructive testing. Crack can be treated as crucial for safety assessment. Epoxy resin has been used in [20], and the active sensing technique using piezoelectric ceramics is used to monitor cracks. Once wavelet method is applied, the relationship between the wavelet signal and bearing capacity after grouting is thus established. These results indicate that the sensing techniques are able to evaluate the strength. Electromagnetic sensing is an effective stress detection method according the piezoresistive effect. Y. Yu et al. [21] have proposed a nondestructive approach that applied eddy current mechanism of finite element technique. The results have illustrated the connection between the applied force and the magnetic field. In addition, numerical simulations have been undertaken to bridge the relationship between the magnetic flux density and the stress information. R. Wu et al. [22] has investigated the challenges associated with corrosion detection of metal under coating. The authors presented a detailed investigation of various techniques based on ultrasonic, acoustic, electromagnetic, radiographic, and thermographic. In [23], Y. He et al. investigated the angular MBN affected by the residual stress. The residual stress was closely correlated to the magneto elastic anisotropy energy. J. Capó-Sánchez et al. have used the angular distribution of MBN energy to predict the magnetic easy axis, which has successfully indicated that the applied uniaxial stress gave origin to a continuous rotation of the magnetic easy axis. M. Neslušan et al. [24] have found a remarkable decrease of Barkhausen noise near the true yield stress which can be used to alert the high risk of incoming breakage. On a separate hand, X. Kleber and A. Vincent [25] have investigated the dependence of Barkhausen noise on elastic and plastic deformations in Armco iron and a low carbon steel to explain the effect of residual internal stresses through magnetoelastic coupling and dislocation-domain wall interaction.

In [26], principal component analysis (PCA) and Tucker decomposition are developed and compared to assess the performance of microcrack detection. Here, specimens with different fatigue microcrack are detected by using the eddy current pulsed thermography (ECPT). In addition, the potential correspondence between crack closure and temperature change has been established. In high-speed train safety inspection, [27] develops a vision technique based on two convolutional neural networks to detect defects. The authors have presented networks which are capable of inherently detecting differences between two images and thus further identifying the changes by using a pair of images. Notwithstanding the above, M. He et al. [28] have found a method for suppressing the effect of uneven surface emissivity of material in the moving mode of eddy current thermography. Y. Gao et al. [29] have reported a ferrite yoke based on ECPT to enhance the detectability of multiple cracks 39. K. Li et al. [30] have illustrated a Helmholtz-coil-based ECPT configuration for the state detection and characterization of bond wire lift-off in IGBT modules. Z. Liu et al. [31] have proposed an L-shaped sensor to diagnose natural cracks in a static system. In [32], M. Goldammer et al. show how NDT can be automated using as an example of industrial applications at the Siemens sector energy.

3. Image and Video Processing

While reservoir fractures are essential locations to gather oil and gas, imaging logging technology has become a mainstream method for obtaining stratigraphic information. In [33], W. Zhang et al. have proposed an optimal path search strategy to effectively identify and extract the fracture information in well logging images. The logging image is first transformed into the optimal path search, and this is followed by the identification of reservoir fractures. Video surveillance systems are often deployed at places such as airports and train stations. However, these systems are prone to interference with cluttered backgrounds. C.-H. Tseng et al. [34] have proposed a person retrieval method to extract the attributes of a masked image using an instance segmentation module. The reported experimental results shows that the retrieval system can achieve effective retrieval performance for multi-camera surveillance systems. In similar line, motion capture technology plays an important role in the production field of film and television. In [35], kinematic constraints (KC) and cyclic consistency (CC) network are employed to study the methods of kinematic style migration. Cycle-Consistent Adversarial Network (CCycleGAN) is developed in [35], and the motion style migration network of convolutional self-encoder has been used as a generator to establish the cyclic consistent constraint. In order to normalize the movement generation to solve the problems such as jitter and sliding step, the kinematic constraints are concurrently used.

In application field of power system, traditional manual inspection methods of a power transmission line (PTL) suffer from the issue of supplying the demand for high quality and dependability for power grid maintenance. The authors in [36] have presented a review of technologies for three-dimensional (3D) reconstruction, object detection, and visual servo of PTL inspection.

In weak-light environments, images suffer from low contrast. In [37], a simple and novel correction method has been proposed based on adaptive local gamma transformation and color compensation. The proposed method converts the source image into YUV color space, and the Y component is estimated using a fast guided filter.

4. Wearable Sensing

The growing application of body area networks (BANs) in different fields makes the low energy clustering a paramount issue. A clustering optimization algorithm in BANs is a fundamental scheme to guarantee that the essential collected data can be forwarded in a reliable path and improve the lifetime of BANs. However, the classical clustering method leads to high cost when constraints such as large overall energy consumption are undertaken. Hence, a binary immune hybrid artificial bee colony algorithm (BIHABCA), a randomized swarm intelligent scheme, is applied in BANs [38]. Furthermore, it designs the formulation that considers both distances between two nodes and the length of bits. The results show that the energy cost of the network optimized by the proposed BIHABCA method decreased the energy cost of transmitting and receiving data in BANs.

In recent years, with the development of wearable sensor devices, research on sports monitoring using inertial measurement units has received increasing attention. J. Fan et al. [39] have designed a sensor fusion basketball shooting posture recognition system based on convolutional neural networks. It has collected 12,177 sensor fusion basketball shooting posture data entries of 13 Chinese adult male subjects aged 18–40 years and with at least 2 years of basketball experience without professional training. The intertest achieved an average recall rate of 89.8%, an average precision rate of 91.1%, and an accuracy rate of 89.9%. In [40], the wearable sensors consist of a neoprene band that contains circuitry for measuring electrodermal activity (EDA), 3-axis motion, temperature, and electrocardiogram (ECG). In [41], for the assessment of emotions, anxiety, mood, depression, and stress, a head-mounted type was proposed by using electroencephalogram (EEG), chest band heart rate variability (HRV), and skin conductance (SC) sensors. In [42], the eyeball is tracked by a wearable device, and the mental state of the person is detected by analyzing the activity of the eyeball. In order to objectively evaluate the human mental health, integrated sensors of mobile phone are applied [43–51, 56].

5. Different Sensing Techniques and Instruments

The ring laser gyro inertial measurement unit has many systematic error terms which seriously affects the stability time and accuracy. A system-level temperature modeling and compensation method is proposed based on the relevance vector regression method [52]. H. Xu et al. [53] have proposed a new indoor people detection and tracking system using a millimeter-wave (mmWave) radar sensor. The recursive Kalman filter tracking algorithm is used to track multiple people simultaneously. The method is lightweight for scalability and portability. For most high-precision power analyzers, calibration before measurement is important to ensure accuracy. W. Zhou et al. [54] have proposed a nonlinear calibration method based on sinusoidal excitation and DFT transformation. In particular, through Fourier transform, the phase value at the initial moment of the fundamental frequency is calculated.

Conflicts of Interest

The authors declare no conflict of interest.

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