Message from Conference Chairs

Welcome to the 22nd International Conference on Advanced Science and Technology (ICAST).

The theme of ICAST 2007 is *Imagination, Innovation and Integration* (3I) of advanced science. The 3I represents the evolution of a successful technology, starting from a scientific imagination and ending with the technology advancement. It is the very purpose of science and technology to make our life better through advances in healthcare, energy and industrial technologies, and clean environment. ICAST 2007 focuses on these topics. There are four technical tracks: *emerging biomedical technology, innovative food technology, advanced industrial technology, and integral environmental issues,* in this one-day conference. Undoubtedly, we will not be able to address every issue of these topics. However it serves as a vehicle to promote the awareness of the eminent science and technology that affects so much our daily life.

We had a very successful session on biomedical technology in ICAST 2006. We continue this forum this year because it is such an important field of science, from which you will be informed the emerging technologies in drug discovery and delivery, stem cell therapy, and basic biomedical research in genomics and proteomics. We thank Dr. Tung-Ling Chen of Rosalind Franklin University of Medicine and Science for her effort to organize this program.

For the first time, ICAST 2007 includes an interesting session on food science from which you will learn the typical manufacturing processes of your daily food. Food safety and regulatory issues will also be introduced. We thank Dr. Alice Shen Cha of Kraft Foods for her effort and support to this track.

As oil price and energy demand continuously rising, it is the right time for us to evaluate the future energy supply. Should it be nuclear or other alternative energies? ICAST 2007 identifies this subject and provides a brief forum for discussion. Energy supply and energy saving are equally important so while we are discussing energy technologies we need to address how to improve industrial processes for better energy efficiency and less environmental concerns. The green house effect and global warming phenomena have become a real threat to our environment. This leads us to include the topics on industrial process control and environmental technologies. We hope that these tracks will bring you awareness of issues on energy and environment.

We sincerely hope that this conference will meet your expectations and that you will have an enjoyable day.

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An Empirical Research on the Relationship between Stakeholders' Eco-Innovative Adoption and Organizational Environmental Performance

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Abstract

One of the most serious challenges the world faces today is the intensify conflict between the indispensable goals of environmental protection and economic development. In order to resolve this dilemma, many scholars have pointed out the importance of eco-innovation (Kao and Huang, 2000b; Wen and Chen, 1997; Porter and van der Linde, 1995; Shrivastava, 1994, 1995). Currently, there is a clear agenda for integrating environmental issues into the innovation process, but this is likely to be a long and difficult task.

The literature on innovation is substantial and covers a wide range of topics (Dalglish and Newton, 2002), generally focusing on patterns of innovation and its diffusion, the relationships between innovation adoption and organization structure (Capon et al., 1992; Damanpour, 1991; Dutta and Weiss, 1997; Gopalakrishnan and Damanpour, 1997; Javanovic and MacDonaald, 1994; Meyer and Goes, 1988), the process of innovation and the economic factors determining the development of innovation (Kay, 1993; Rogers). The nature of external factors has also been an increasing focus for innovation's research. Therefore, greater engagement with a wide set of stakeholders, and integration between existing research on many aspects of environment and innovation, especially eco-innovation, is required.

This study proposes a framework that synthesizes the relationship of eco-innovative adoption and organizational environmental performance by the antecedence of stakeholders. With respect to eco-innovation, refers to Ramus (2001), research divides into eco-technical innovative adoption and eco-administrative innovative adoption. In term of stakeholders, refer to Henriques and Sadorsky (1996, 1999), research divides into three categories of organizational, socio-economic and market stakeholders. In respect of organizational environmental performance, refers to Huang (2001), divides into managerial performance and operational performance.

The samples taken for this study is mainly from Taiwan's four manufacturing sectors which had earned the ISO-14001 certificates prior to the end of 2004. In 235 valid samples, this study finds that the eco-innovative adoption have significantly positive correlation with organizational, socio-economic and market stakeholders. This study also finds that the eco-innovative adoption has significantly positive effect on managerial and operational performance. Operational performance has significantly positive influence on managerial performance.

Keywords: Eco-Technical Innovative Adoption, Eco-Administrative Innovative Adoption, Stakeholders, Organizational Environmental Performance, Structural Equation Modeling.

RADIATION CURING TECHNOLOGY (UV&EB)

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Abstract

Industrial attraction to radiation curing is being spurred not only by the energy shortage and EPA standard protection, but also by the need to be cost-effective and the increase of application innovations. It is one of the many new exciting "Green Technologies." Compared to conventional coatings, inks and adhesives, radiation curing is a solvent free (100% solid), very high curing speed that saves tremendous energy in the polymerization process. Basically, radiation curing is still a chemical process which uses high intensity energy source ultraviolet light (UV) or electron beam (EB) to convert low molecular weight materials to higher molecular weight finished products through chain extension and cross-linking processes. Over the last two decades radiation curing has conquered an ever increasing share of the market in the coating, ink and adhesives industries. It can be applied in-line in a wet trap or dry trap mode or off-line using a variety of conventional type application equipment. The driving forces for UV/EB process were purely economic – improving rate and obtaining superior performance properties. The use of radiation curing has increased drastically in recent years. It is currently being used with a variety of substrates including paper, plastic film, metal, glass, wood and ceramics for protective and bonding purposes. It offers an alternative to the solvent-based, water-based and hot-melt technologies.

R&D OPPORTUNITIES IN BIOREFINARY

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As the U.S. transitions to a sustainable economy, biobased feedstocks will replace fossil feedstocks for fuels, chemicals, and materials. As we use biotechnology to advance the production of sustainable biomass resources and microbial conversion to fuels and valuable products, product recovery, separations, energy use, and the cost to be integrated biorefineries will become the major technoeconomic barrier. As we expand from corn to other biomass feedstocks, economically successful biorefineries will need to provide a suite of fuels (ethanol, butanol, biodiesel, green diesel), chemicals and feed (organic acids, polyols, amino acids), and materials (biobased plastics, resins). To achieve this transformation will require highly integrated facilities that efficiently convert, recover, and separate a suite of products minimizing energy use and capital requirements. For example, ethanol recovery in dry mills requires about 19,000 BTUs per gallon. This represents about 25 % of the energy in the ethanol fuel. Cellulosic ethanol will require even more energy because the fermentation will produce a more dilute product. Membrane-based separations could reduce the energy requirements for ethanol production by a factor of two or more. Thus membrane-based separations could dispel with the concerns of net energy balances. Conversion and separations must be considered and evaluated in the context of an integrated process. Decisions regarding the type and point in a process train where a separation technology (or combination of technologies) should be applied must be made based on the results of rigorous process techno-economic analyses. The major focus will be on applying membrane-based separations along the post-sugar production process train, as envisioned by the highly simplified biorefinery model illustrated in the figure. In this presentation, the R&D opportunities utilizing membrane technologies mapped by the direction of US department of Biomass Program will be discussed.

ADVANCED SENSOR TECHNOLOGIES FOR NEXT GENERATION VEHICLES

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Abstract:

At Argonne National Laboratory (ANL), we developed a sensor system capable of monitoring engine-out emissions from an internal combustion engine to ensure compliance with 0n-board Diagnostics II regulations as defined by the California Air Resource Board and the U.S. Environmental Protection Agency. Three types of sensor technologies, ultrasound, microwave, and ion-mobility spectrometry (IMS), were evaluated for engine-out emissions monitoring. Two acoustic sensor technologies, surface acoustic wave and flexural plate wave, were evaluated for detection of hydrocarbons. Microwave technique uses a cavity design and measures the resonance frequency shifts resulted from the presence of trace organic compounds. The IMS technique was chosen for further development into a practical emissions sensor. An IMS sensor with a radioactive ^{63}Ni ion source was initially developed and applied to measurement of hydrocarbons and NO_x emissions. For practical applications, corona and spark discharge ion sources were later developed and applied to NO_x emission measurement. Results of NO_2 in dry nitrogen and in a typical exhaust gas mixture are presented. The sensor response to moisture was also evaluated. A cooling method to control the moisture content in the gas stream was examined. Results show that using a thermoelectric cold plate can reduce the moisture effect. Because of its high sensitivity (ppm), fast response (ms), and robust, IMS can provide real-time feedback control for the fuel control system of a low-emission vehicle. The design and performance of a laboratory prototype sensor are described.

Security-Constrained Unit Commitment with Volatile Wind Power Generation

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Wind energy has become increasingly popular across the globe. It is reported by the Global Wind Energy Council (GWEC) that global wind energy installation rose by 11,531 MW in 2005, which represents an annual increase of 40.5%. Such figures demonstrate the prosperous future of wind power development. However, the intermittent and volatile nature of wind power generation will impact power system characteristics such as voltages, frequency and generation adequacy which could increase potential risks to power system operations. In some parts of the US, intermittency of wind could amount to several hundred megawatts in a matter of hours. Likewise, the volatility of wind power has a tremendous impact on power system operations which poses new challenges for the electricity market management. Control room operators in competitive electricity markets apply optimization methods for managing the security of the system while utilizing the merits of wind power.

In this talk, a security-constrained unit commitment (SCUC) algorithm by taking into account the intermittency and volatility of wind power generation will be presented. The SCUC problem is solved first with the forecasted intermittent wind power generation. Next, possible scenarios are simulated for representing wind power volatility. The initial dispatch is checked and generation redispatch is considered for satisfying the hourly volatility of wind power in simulated scenarios. If the redispatch fails, Benders cuts are returned to revise the commitment problem. The iterative process between the commitment problem and feasibility check subproblem will continue until simulated wind power scenarios can be accommodated by redispatch. Numerical simulations indicate the effectiveness of the proposed algorithm for managing the security of power system operation by taking into account the intermittency and volatility of wind power generation.

BIOGRAPHY

Jianhui Wang received his Bachelor degree in Management Science and Engineering and Master's degree in Technical Economics from North China Electric Power University, China, in 2001 and 2004, respectively. He obtained his Ph.D in Electrical Engineering from Illinois Institute of Technology in 2007. Presently, he is a postdoctoral appointee with CEEESA at Argonne. His research interests include power systems economics, optimization and agent

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Protection of the Environment—
Assessing Radiological Doses to Animals and Plants

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Stakeholders and regulators are increasingly interested in demonstrating that the environment is protected from the potential effects of ionizing radiation. For the past three decades, most such efforts have been indirectly based on established radiological dose limits that are considered protective of human health. The use of human radiation protection to infer ecological protection has been based on the assumption made by the International Commission on Radiological Protection (ICRP) that "if man is adequately protected then other living things are also likely to be sufficiently protected" (ICRP 26, 1977). This assumption is now being revisited, and its scientific basis is being questioned. A recent ICRP publication stated that, "ICRP therefore needs to revise its current system of protection, and particularly, develop a comprehensive approach to the study of the effects on, and protection of, all living matter with respect to the effects of ionising radiation" (ICRP 91, 2003). Dose rate guidelines and approaches for evaluating doses to biota are under development by, or becoming available from, several countries and international organizations. Unlike the case for human dose calculations, however, there are no standard dose conversion factors available yet. The dose to flora and fauna must be calculated from the first principle (i.e., by calculating the energy absorbed by using a Monte Carlo radiation transport code). The first step in biota dose calculation is to estimate the radionuclide concentration in the tissue of biota (animals or plants). The methodology for calculating radiological doses to biota has been developed and implemented in the RESRAD-BIOTA code. This code is available for download from the RESRAD web site at http://www.evs.anl.gov/resrad.

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Planar Directional Finding Antenna Array in Wireless Systems

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Abstract

Although MIMO (multiple input and multiple output) system has received many research interests, single-channel planar direction finding methods have found useful wireless applications recently. A basic approach is the use of pseudo-Doppler method in a circular antenna array. The phase of the receiving signal at each of the antenna port is sampled sequentially. Several signal phase processing techniques were suggested. Among them, phase lock loop (PLL) method could provide the accuracy within 1 degree in Angle of arrival (AOA) estimation, but with much a more complex circuitry. The range of only several meters could be a problem for some applications. Another limitation is that the AOA accuracy deteriorates as the elevation angle decreases from 90 degrees. In this paper, a full-wave electromagnetic analysis is applied to an 8 elements circular quarter-wave monopole array. Eight quarter-wave monopoles (designed at the 2.4GHz ISM band) are mounted at equal-space on a circular printed circuit board backed by an infinite ground plane, and each is attached to the end of a microstrip transmission line. The circuit board diameter is about 12.5cm (one wavelength at 2.4GHz).

The simulated antenna voltages that include mutual coupling are imported into MATLAB to retrieve the AOA based on an ideal PLL algorithm of a pseudo-Doppler system designed without mutual coupling.

The results are applied to an experimental antenna, which was constructed and measurement results are reported. The voltage at each of the eight receiving port is obtained numerically and is imported into MATLAB to emulate the signal processing algorithms including the PLL, MUSIC, Beam steering, or minimum norm. Antenna mutual coupling effect in the pseudo-Doppler and PLL methods as well as AOA estimation using a MUSIC interpolation algorithm are investigated. The effects and the limitation on the incident-wave elevation angle are also demonstrated.

Distributed Narrowband Vector Antennas for Direction of Arrival Applications

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In the last decades, the problem of finding the direction of arrival (DoA) of an incoming wave in multipath situation has been thoroughly investigated. At the present time, the most common way to estimate the DoA of an incoming electromagnetic signal is through array antennas. However, array antennas show poor performances in the presence of multipath environment. A way to overcome at this problem is to implement arrays of vector antennas, since they offer, at least, the following advantages: (1) Using the full number of degrees of freedom in wireless EM communications; (2) Better performance during fading situation; and (3) No of ambiguity in the estimation of the DoA.

Because of the aforementioned benefits, the signal processing community has welcomed its concept and has produced rich literature that shows how such antennas can drastically improve the DoA estimation.

To the best of the knowledge of the authors, no actual realization of a full 6D co-located vector antenna with acceptable performance has yet been manufactured. The main reason comes from the fact that it is not trivial to physically co-locate all the six elements at one single point. However, recent studies have also shown that the performance of such antennas improves if its elements are distributed in the space.

For this reason, we are designing, manufacturing and testing narrowband 6D distributed vector antennas. Our experiments consist in placing the distributed 6D vector antenna on a steering platform and then measures the entire six components in both free space and multipath scenarios. Then, we process the readings using advanced DoA estimation techniques. Knowing a priori the actual DoA, we can confirm the agreement between theoretical estimation and real direction of arrival. We will test separately both linear and circular distribution.

We wish to contribute to fill the gap among the signal processing theories and techniques regarding DoA estimation, and the practical realization and implementation of such techniques in radar systems.

Novel Slow-Wave Structures for Miniaturized Sensor Electronics

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The rapid growth of today's wireless communication systems urges on the demands for smaller device size with better performance. RF passives remain the bottleneck for device miniaturization on circuit boards, for their electrical dimensions determine their characteristics. Slow-wave factor (SWF) is related to the component size reduction. With the SWF being made very large which results in a very small wavelength, the RF passives or antenna size can be reduced dramatically. Three-dimensional (3D) micro or nano-fabrication of metallic components within common dielectric or semiconductor substrates becomes promising with the advances of microelectronics manufacturing technology. By using 3D material metallization, a wire, a slot or a disc plate can be volume integrated by compressing, twisting, and fragmenting, with the purpose of tailoring their electrical dimensions.

This paper proposes a novel slow-wave structure using four-layer periodic metallization. The unit cell of the structure includes a one-layer or two-layer loop and a composite capacitor made of the combination of two planar interdigital capacitor and one parallel capacitor. Such 3D periodic metalized unit cell enhances largely the series inductance and the shunt capacitance of a unit cell of a normal transmission line (T.L.), and thereby significantly improves the SWF, while keeping the characteristic impedance and attenuation constant comparable to the normal T.L.. Our designed prototype on an FR4 substrate and measured results show that the SWF of the new structure is 14 and is nearly 8 times of that of a normal 50 ohm microstrip line on the same substrate. Based on this new T.L., we design a quadrature hybrid and electrically small monopole antenna at 2.4GHz for the ISM band application. The simulated results in HFSS and IE3D show that our hybrid on a Roger substrate occupies the area of only 17% of that of a normal microstrip hybrid; the designed small antenna has its 10dB-bandwidth of 22.556% at the center frequency 2.66GHz.

RFID Antenna Size Minimization Using Double-layer Periodic Structures

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Radio frequency identification (RFID), which uses RF signals for automatic object recognitions, has seen tremendous growth in many applications, such as animal tracking, retail item management, electronic toll collection, and automation of supply chains. A RFID system consists of RFID transponders (tags) and RFID readers. RFID tags are usually attached to the objects and the readers read information from the tags using RF signals. RFID tags include antennas and RF chips. A commercial tag requires small size, low cost, consistent performance, and good reading range. Due to the size constraint, tag antennas are also required to self resonance and self tuned to the integrated chips, without additional L/C tuning or matching networks.

Current UHF RFID systems use frequency in between 860-960 MHz, the tags usually use single-layer planar structures, which limit the tag miniaturization and results in an area of about 100*10 mm^2 using meander lines. This paper discusses further size reduction using double-layer loop-patch periodic planar structures. This double-layer periodic structure is evolved from a multilayer slow-wave electromagnetic band-gap (EBG) structure. The unit cells of a two double-layer periodic structure uses series connected double-layer loops and single-layer patch, referred to as the L-C setup or uses two double-layer loops noted as the L-L setup. The double-layer periodic L-C and L-L setups are used to form antenna dipoles. Their antenna performance is comparable to a normal single-layer dipole.

The prototype test results show that the new proposed structures has similar performance, but with about 50% size reduction. The structure is based on two 30mil-layer FR4 materials and is inherently a low-cost solution.