

**ENGINEERING SCIENCES
AND TECHNOLOGY**

EST - 01

SIMULATING CROWD EGRESS DYNAMICS USING MULTIPLE AGENTS AND SOCIAL COMPARISON THEORY

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The understanding of crowd movement is important to planning and improving shared public places, not only to effectively and efficiently facilitate the comfortable movement of individuals, but also to guarantee the safety of individuals, especially under conditions of danger when quick and orderly evacuation of a mass of individuals is desired. Because data from real evacuation are hard to obtain and conducting replicate experiments on humans is ethically questionable, the characterization of crowd egress dynamics has been confined to simulation and modeling. We introduce a simulation approach that hybridizes multi-agent systems (MAS) with the social comparison theory (SCT) that provides the capability to simulate more human crowd phenomena than the more common social force model (SFM). SFM has been proven to show real world crowd phenonema such as the “faster-is-slower” in escape panic, “arching” and “bursty exit” as side effects to “clogging” on exit ways, “flocking,” “bidirectional lane formation,” and “roundabout formation.” Simulations using our MAS-SCT hybrid are able to exhibit all these phenomena and two more individual behaviors: (1) *Imitation* – where individuals tend to move in groups whose members they think would have the same opinion as theirs; and (2) *Contagion* – where people tend to “adopt” the behavior of others in the same group. Because of these, we propose that our MAS-SCT approach is more akin to modeling humans and real-world objects in very realistic ways, and thus can be used with higher confidence in performing *what-if* scenarios to aid decision makers, designers and researchers.

Keywords: simulation, crowd egress dynamics, MAS, SFM, SCT

EST - 02

**USING DATA RETRIEVALS FROM CALIPSO AND
AERONET: CASE STUDY OF AEROSOL OPTICAL
THICKNESS OVER THE PHILIPPINES AND
THE EAST ASIAN REGION**

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The utilization of aerosol data from satellite measurements has the advantage of identifying pollution episodes in places where there are minimal to no data measurements. Such applications are available from satellite sensors polar-orbiting the earth on a regular basis, called the A-train. This study uses the vertical feature mask from the Cloud-Aerosol LiDAR and Infrared Pathfinder Satellite Observations (CALIPSO) to determine the vertically-resolved aerosol quality over the Philippines. On the ground, data from the Aerosol Robotics Network (AERONET) station in the Manila Observatory was used to quantitate the Aerosol optical depth (AOD). From a selected time frame of satellite data for the whole month of November 2011 it was observed that the AOD on the ground level reached as high as 3.3 during the afternoon of November 2, 2011. Severe cases of pollution from East Asia, specifically from China, were also evident during the study period. Satellite data retrievals have shown their applicability for aerosol studies in the Philippines when technologies for depth comparison of aerosol levels with the neighboring Asian countries are not available.

Keywords: A-train, aerosol optical depth, satellite constellation, Philippines, CALIPSO, AERONET

EST - 03

MODELING THE FATE AND TRANSPORT OF PESTICIDES IN AN IRRIGATED RICE AREA

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For fast, effective, and economical assessment and continuous monitoring of the concentration of pesticides in an irrigated rice area, the use of models plays a very important role. This study aimed to assess the extent of pesticide contamination of water in the paddy field and drainage channel and to develop a model that can be used to determine the fate and transport of pesticides in an irrigated rice area. Three 144 square meter experimental paddy plots planted with MS 16 variety of rice and applied with Lambda cyhalothrin insecticide was used in the study. A computer-based transport model was developed that was used to simulate the concentration of pesticide residues in the ponded water and drainage channel by mathematically tracking the total mass of chemical residues from the loading point to the drainage stream in terms of mass balance. Results of the model simulation predicted that the concentration of Lambda cyhalothrin insecticide applied in the paddy field would diminish at the rate of 42.38% on the first day, 90.64% on the second day, 98.26% on the third day, 99.10% on the fourth day, to almost nil concentration on the fifth day. As indicated by the correlation analysis and test of significance between the observed and predicted data, the model can accurately simulate the actual pesticide concentration in the ponded and drainage water. The model can be enhanced by taking into consideration the advection process in the drainage stream and by linking of the model to other available models by either using the input/output of the model as an input/output to the other model or vice versa.

Keywords: modeling, fate and transport, irrigated rice area, insecticide concentration, Lambda cyhalothrin

EST - 04

**POINT TO SURFACE MAPPING OF SELECTED
SOIL PROPERTIES USING DIFFERENT
INTERPOLATION TECHNIQUES**

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Three spatial analysis algorithms, namely, inverse distance weighted (IDW), kriging, and spline, were used to interpolate soil pH and soil texture properties from sample point data. A systematic sampling method was employed to collect soil samples for laboratory analysis. Interpolation was carried out in ArcGIS 10. Root mean square error was calculated to evaluate the relative precision of the interpolation methods. IDW had the lowest RMSE for pH, OM, clay, and sand while kriging had the lowest RSME in silt and the spline had the highest for all of the four properties. Lower RMSE implies a better interpolation result. While the relative precision results appeared to be consistent, the analysis of variance revealed that the three interpolation methods were not significantly different ($p>0.05$) from each other. In addition, soil map generated through kriging had the least visual appeal among the three methods. The major outputs of the interpolation are surface maps (continuous data) of the five soil attributes. These maps are important for decision making regarding land use, soil-plant compatibility, yield analysis, and soil improvement activities. Future research should take into account the topographic factors, existing vegetation and other important site properties.

Keywords: soil interpolation method, soil mapping, IDW, kriging, spline

EST - 05

**TOWARDS A FILIPINO-CENTRIC DESIGN FOR DIGITAL
INPUT DEVICES THROUGH AUTOMATED HAND
ANTHROPOMETRY**

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We conducted an anthropometric survey of the hands of 91 respondents coming from different parts of the Philippines. Our purpose was to come up with an initial profile of the Filipino hand that may be used to design computer keyboards, and other digital input devices that will fit the Filipino groups based on gender, age, and the type of location of origin (rural or urban). To provide solution to the time, consistency and accuracy problems brought about by following a meticulous process in manual anthropometry, we developed a computer-based process by combining techniques in machine vision and digital image processing to furnish anthropometry researchers a fully automated system that is fast, yet provides consistent and accurate body measurements. The result was the anthropometric data of the hands of Filipinos based on gender, type of location of origin, age group, height and weight. We compared the anthropometric data with the mean dimension of standard desktop computer keyboards, products which are usually imported and may have been optimally designed for other nationalities. We found out that the Filipinos whose hand measurements fall below the 25th percentile will not be able to comfortably make several key combinations. Because of this, we recommend that product designers and importers use the anthropometric profile of the Filipino hand so that they will be able to provide the Filipinos with fit, useful, comfortable, and safe digital input devices.

Keywords: hand anthropometry, Filipino-centric keyboard, machine vision, digital image processing, automation

EST - 06

**DEVELOPMENT OF AN OPTICAL DETECTION DEVICE
FOR AMMONIA IN WATER**

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The objective of this study is the fabrication of a handheld, simple to use optical detection device which detects and quantifies ammonia contamination in water. The sensor is based on irreversible color changes that occur subsequent to the reaction of the Rochelle salt and Nessler's reagents with ammonia which gives off a flesh color. The sensor uses LED light source shining on an LDR which is connected to a circuit supplying a constant voltage. When the colorimetric reaction has taken place, light shines through a vial containing the sample, and onto a light-sensitive circuit. A clear tube of water is the BLANK and has zero absorbance. A fraction of the incident light that is blocked by the sample can be used for quantitative determination of ammonia in water. The ammonia concentration is related to the absorbance reading, following Beer's law. The amount of incident and transmitted light are expressed in voltage units, by a voltmeter. The sensor shows outstanding response over the range of 0.1 to 10 ppm concentrations of ammonia. Excellent sensitivity and linearity ($R^2=0.91$) has been achieved using the sensor, working with 5 replications per particular concentration. The practicality of the sensor has been demonstrated by using it for the field determination of ammonia in water from different sites in Aklan. The other features of the sensor include: ease of manipulation, low cost, ruggedness, versatility, and adaptability for use for other analytes for as long as there is a color change after the analyte-reagent reaction.

Keywords: sensor, ammonia, LED, voltage, detection device

EST - 07

ENHANCING THE USE OF INDIGENOUS IRRIGATION SYSTEMS AND PRACTICES

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This study was conducted to identify existing indigenous irrigation structures and practices of the farmers in Ilocos Norte during the wet and dry seasons of 2012 to document these practices, to explore the importance of such practices to water conservation and management, and to design an enhancement program for the use of such systems. The study areas considered were upland and coastal barangays of Pasuquin, Ilocos Norte. Farmer leaders and senior citizens within the identified study areas were interviewed regarding the existence and use of water conservation practices and its importance to water management. Ocular inspection and documentation were done on the identified structures. Results showed that: 1) there exists traditional irrigation systems used by farmers in the study areas. Irrigation structures such as earthen canals, farm reservoirs lined by rocks, and earthen reservoirs within the farm itself were built and used generations back; 2) farmers employed both natural and man-made structures to impound and use water during both the rainy and dry seasons; and 3) water management practices included the use of mud to control water from the farm ditch to the field in the absence of gate valve structures. Enhanced productivity of these systems can relieve pressure on surrounding areas. The sustainability of indigenous irrigation systems is thereby directly linked to the environmental sustainability of the watersheds of which they form a part. From a social and cultural perspective, the institutional arrangements embedded in traditional irrigation systems are important both to the political stability of the immediate region, and for the cultural integrity of the people whose land is to be irrigated.

Keywords: traditional, modern, irrigation systems, practices, Ilocos Norte

EST - 08

**CALAMANSI (*Citrus microcarpa*) SEED CHARCOAL
AS WATER FILTER**

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Rain water is one of the potential sources of water supply at Cebu Technological University. However, the water is contaminated with fecal coliform due to bird and rodent wastes. Calamansi seed charcoal filter improved the quality of rainwater based on biological parameters, in particular, total bacterial count and total coliform count, as well as physico-chemical parameters including alkalinity, total suspended solids, total dissolved solids, salinity and turbidity. The water sample filtered using calamansi seed charcoal had the least bacterial count and fecal coliform compared to the rain water samples before filtering, which were comparable to the quality of commercial bottled water. The rain water samples filtered with calamansi seed charcoal reduced the levels of alkalinity, total dissolved solids and turbidity. Verification studies on filtered rain water using calamansi seed charcoal will be conducted for liquid hand wash diluents.

Keywords: *calamansi* seed, charcoal, filter, rain water

EST - 09

**CRYSTAL QUALITY DEPENDENCE ON THE
NONVOLATILE RESISTANCE SWITCHING IN 3C-SiC
THIN FILM GROWN BY GAS-SOURCE MOLECULAR
BEAM EPITAXY USING MONOMETHYLSILANE**

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For the next-generation of nonvolatile memory (NVM) devices, 3C-SiC/Si based NVM devices are attracting much attention because of its superior mechanical, thermal, and electrical properties. In this study, the resistive switching (RS) characteristics of the resistive random access memory (ReRAM) device based on 3C-SiC epilayer grown using monomethylsilane gas-source molecular beam epitaxy (GSMBE) were investigated. Results reveal that the growth temperature of the 3C-SiC epilayer plays a vital role for the two-terminal nonvolatile RS property of the Au/SiO₂/3C-SiC/Si/Al device. We found that there is a linear relationship between 3C-SiC epilayer degradation and electronic hysteresis. The RS behavior of the 3C-SiC epilayer was highest when the growth temperature was 800°C and this was demonstrated by applying bias on the Au and Al electrodes. *I-V* characteristic showed a bipolar switching behavior with a memory window of 2.1 V and a threshold voltage of 1.8 V under a minimum applied sweeping voltage of ±5V. *C-V* characteristic indicated a counterclockwise hysteresis direction which signifies a tunneling capture of free charges. Endurance test gave a typical rewriting cycle of about 10⁵ cycles. These observations suggest that 3C-SiC/Si based NVM devices may be well suited for ultrahigh-density memory applications.

Keywords: crystal quality dependence, nonvolatile resistance switching, 3C-SiC thin film, gas-source molecular beam epitaxy, monomethylsilane

EST - 10

**CONSOLIDATED BIOPROCESSING OF SUGARCANE
(*Saccharum officinarum*) BAGASSE TO ETHANOL
USING RUMEN FLUID**

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Cellulosic ethanol is an environmentally friendly and renewable transportation fuel produced from a wide array of feedstocks, including non-food plant materials, such as agricultural wastes, dedicated energy crops such as switchgrass, sugarcane bagasse, and wood products. This study was conducted to determine the potential of sugarcane bagasse as a substrate for ethanol production in Single Stage Consolidated Bioprocessing (SSCBP). Specially, it sought to determine: 1. the biodegradation activity of rumen fluid microorganisms in the major biomass fractions (hot water extractives, lignin, hemicellulose and cellulose) of sugarcane bagasse, 2. the deconstruction of cellulose to glucose with time, and 3. the fermentability of 2nd generation sugar from bagasse to bioethanol. Glucose released and ethanol produced were monitored from day 1 to day 12. Three concentrations of rumen fluid – 1% 10%, and 20% - were used in the experiment. The positive degradation effect of the different concentrations of rumen fluid was very evident. Hot water extractives, lignin, hemicellulose and cellulose were reduced to 29.33%, 13.33%, 33.33%, and 58.67%, respectively. Glucose content after rumen fluid treatment decreased with time. At day 6, it yielded 2.33% on dry biomass and was progressively reduced to 1.17% in day 12. Saccharification efficiency was highest from day 6 to day 8 at 4.57% - 5.56%. The results indicate the potential of rumen fluid microorganisms in SSCBP for the biodegradation of sugarcane bagasse for cellulose ethanol production.

Keywords: consolidated bioprocessing, cellulosic ethanol, biomass constituents, cellulosic biomass, saccharification, lignocellulosic biomass

EST - 11

**PRELIMINARY STUDY ON THE PRODUCTION OF FUEL-
GRADE ANHYDROUS ETHANOL USING ACTIVATED
ZEOLITE AS DEHYDRATING AGENT**

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A 5-stage column, packed with activated Zeolite, was successfully used to produce absolute ethanol from reflux-distilled hydrous ethanol. This study was a follow up on our successful exploratory experiments to produce azeotropic ethanol from first and second generation feedstocks. We sought to develop a column to produce anhydrous ethanol in order to comply with the Philippine National Standards (PNS) as prescribed in the Biofuels Act of 2006. Our initial attempts in this process included the use of non-polar solvents to form a ternary azeotrope for reflux distillation, and the use of various desiccants, none of which proved satisfactory in the absolute dehydration of hydrous ethanol. We report here the successful production of anhydrous ethanol from an assembled 5-stage column packed with 100 grams of activated zeolite as dehydrating agent. Three phases of operations of the column was performed. In Phase I, 500-ml of reflux-distilled ethanol with 89 % v/v ethanol is poured into the column and 446 ml with 96.2 % v/v ethanol was collected. In Phase II, the same column was used and packed with the same dehydrating agent. A 500 ml feedstock with 95 % v/v ethanol was poured into the column and an average of 475.2 ml was recovered with 99.5 % v/v ethanol. In Phase III, the recovery of absorbed ethanol in the column was attempted. To do this, a 150 ml of distilled water was poured into the column and 102 ml was recovered with 12.2 % v/v ethanol. The preliminary results of these studies indicate that the improvised 5-stage dehydrating column is effective, more economical and easier to operate than ternary azeotropic distillation as well as the use of other dessicants. The simplicity of the system enables less supervision of technicians working in the lab.

Keywords: ethanol, absolute, azeotrope, hydrous, anhydrous

