ENGINEERING

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ABSTRACTS

Civil Engineering Archaeology in Indiana: Programmatic Remarks. Aldo Giorgini, School of Engineering, Purdue University, West Lafayette, Indiana 47907.——A tentative definition of Civil Engineering Archaeology is introduced in order to delimit the scope of the research. A program for the collection and the preservation of records related to Civil Engineering artifacts in Indiana is being developed in some detail, with a warm invitation to people concerned with the history of technology in the state to form a communication network for the exchange information.

A Multispectral Satellite Land Use Survey of a Small Urban Area, Terre Haute, Indiana. M. T. Lewellen, Department of Geography and Geology, Indiana State University, Terre Haute, Indiana 47809 and S. J. Kristof, Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, Indiana 47907.——Multispectral scanner data, obtained over Terre Haute, Indiana at an altitude of 915 km, were analyzed by computer-implemented techniques to evaluate the utility of satellite data for land use classification of a small urban area. Terre Haute and the surrounding area were used to define classes. The municipal boundary was then delineated on an IBM Image Display System and only data points within the city were considered in the final land use survey. Several land use classes, such as commercial industry, residential, trees, grassy (open) areas, and water were identified. In this study the percentage of correct classification of land use types was found to vary greatly with some classes, depending on the date the data were collected. Classes containing green vegetation were not spectrally separable using January data. Use of May data resolved this problem and improved the percentage of correct classification of the other land use types.

Bedrock Geology as a Factor in Soil Slides in Southern Indiana. Henry H. Gray, Indiana Geological Survey, Bloomington, Indiana 47401.——Several types of landslide occur in southern Indiana. Prominent among these are soil slides, in which a soil blanket generally 5 to 15 feet thick moves down a sloping soil-bedrock interface.

Soil slides occur where water percolating downward through the soil encounters impermeable argillaceous bedrock. The water collects at the soil-bedrock interface and seeps downslope along the interface. A zone of weathered rock at the interface appears to contribute to the instability, but the sliding itself usually is initiated by man's activities.

Natural soil sliding may have been common in the geologic past, but it is uncommon in the present climatic regime and is not a reliable guide to metastable slope conditions. The presence of a slide hazard must therefore be predicted on the basis of the geologic factors that make it possible—a sloping soil-bedrock interface and argillaceous bedrock of low permeability. These conditions are especially associated with certain bedrock units in the southern Indiana uplands. Notable are the Kope Formation (Ordovician age) in southeastern Indiana, certain parts of the Borden Group (Mississippian) in south central Indiana, and shales of late Mississippian and Pennsylvanian ages in southwestern Indiana.

Multispectral Satellite Data Applied to Land Use Studies in Vigo County, Indiana. S. J. KRISTOF, Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, Indiana 47907, and M. T. LEWELLEN, Department of Geography and Geology, Indiana State University, Terre Haute, Indiana 47809.——ERTS-1 multispectral data from four passes over Vigo County, Indiana were used for land use determination. Single channel and multiple channel data were interpreted visually; the data were also analyzed using computer-aided analysis techniques developed at the Laboratory for Applications of Remote Sensing (LARS) at Purdue University. With the data over Vigo County it was possible to identify and map the following six Level I categories: urban and built-up land, agricultural land, forest land, water, non-forested wetland, and barren land. Also an attempt has been made to identify Level II categories of agricultural land: cropland and pasture; Level II categories of non-forested wetland: vegetated and bare; and Level II categories of water: streams, waterways and lakes.

These results show that land use mapping appears feasible when using a combination of visual interpretation and computer-aided analysis of satellite multispectral scanner data. With these data it is possible to formulate an up-to-date overview of land use on a basis that is uniform in date, scale and categorization in accordance with scheme described in *Land-Use Classification System for Use With Remote-Sensor Data.*

Surface Diffusivities on Activated Carbon Adsorbing from Liquids. CHARLES D. MOSEMAN and KWANG-CHU CHAO, School of Chemical Engineering, Purdue University, West Lafayette, Indiana 47907.—— Agitated slurries of activated carbon particles are of growing importance for the adsorption and removal of pollutants found in the secondary effluent of waste treatment facilities. For the purpose of engineering design of such systems information is required regarding the fluid-to-particle mass transfer rate and the rate of diffusion in the particles.

In this study we determined the adsorption rates for carbon particles of various sizes, and from the experimental results evaluated the fluid-to-particle mass transfer coefficient, and rate of diffusion in the particles. The fluid-to-particle mass transfer coefficient was found to

agree with Kolmogoroff's theory. Our main interest was therefore to study the rate of intraparticle diffusion.

Intraparticle surface diffusivities were determined for xylose and arabinose. The two substances were found to have a linear equilibrium isotherm in the entire concentration range of this study and thus well suited to the study of intraparticle diffusion for the mathematical theory of such systems has been developed.

Additional surface diffusivities were taken from the literature and a correlation of surface diffusivities on activated carbon is proposed

$$D_s = D_o\, e^{-aq/RT}$$

where D_o and a are constants and q is the heat of adsorption. Values of q were determined in this investigation for the data used.

Particle Contacts in Discrete Materials. D. ATHANASIOU-GRIVAS and M. E. HARR, Purdue University, West Lafayette, Indiana 47907.—— This paper has as its objective the presentation of some recent findings concerning granular materials. Experiments were performed with randomly arranged bulky particles of odd shapes. The main characteristics of the samples tested were they drained readily and had little tendency to swell upon wetting.

An experiment was devised to study the relationship between particle contacts and the porosity of various mixtures of granular materials. The number of contacts per particle was determined by pumping paint through the sample and allowing free drainage; after which, visual counts are made. It was found that the relationship $N_c \cdot n = 3$ can be answered for practical purposes, where N_c is the number of contacts per particle and n is the volume porosity of the sample.

The mode of deformation of some packings of glass balls were studied in a series of conventional triaxial tests employing a video camera and tape recorder. It was observed that sliding predominates at the upper and lower surfaces of the specimen while rotation is far greater at the curved surface of the specimen than its interior. Finally, the pattern of deformation along the curved surface was found to exhibit a spiral-like pattern.

Isomorphism of Statistical Turbulence and Quantum Theory.[1] CZESLAW P. KENTZER, School of Aeronautics and Astronautics, Purdue University, Lafayette, Indiana 47907.——Previous investigations of fluid turbulence reveal striking analogies between mathematical formalism of statistical turbulence and that of the quantum theory. It is shown that these analogies follow as necessary consequences of the Fourier representation and of the uncertainty in simultaneous determination of conjugate variables, e.g., position and wavenumber or frequency and time. The quantum theory provides mathematical tools for treatment of strong interactions between normal modes of a turbulent field. An understanding of such interactions may be useful in studying generation of noise in turbulence as well as in predicting other processes in turbulent flows and in describing turbulent motion itself.

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Inventory Control of New Product Lines. ARUNACHALAM RAVINDRAN, School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.——In the past, contagious distributions have been successfully applied in Bacteriology, Entomology and Accident Statistics. Here the notion of contagious distributions is applied in the inventory control of new products and seasonal goods, which have an underlying "true contagion" for their demands; namely, the influence of past demands on future occurrence of demands.

A contagious distribution is derived by assuming a modified Poisson process where the demand rate at any instant of time depends on the past demands prior to that instant. Using this contagious distribution, a multi-period inventory model will be discussed for new product lines with a "fixed periodic review policy". An optimal s-S order policy is derived as a function of the initial stock level and the review period. Seasonal or style goods are treated as single-period inventory problems with contagious demands. An algorithm is developed to compute the iptimal order policy and the optimal length of the period.

Other practical applications of this model in health services, library systems, and military combat operations will also be discussed.