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for simulating triboelectric charging. Adhesive image-charge forces acting on charged particles touching conducting surfaces can be up to 50 times stronger if the charge is located in discrete spots on the particle surface instead of being distributed uniformly over the surface of the particle, as is assumed by most other models.

Besides being useful in modeling particulates in space and distant objects, this modeling technique is useful for electrophotography (used in copiers) and in simulating the effects of static charge in the pulmonary delivery of fine dry powders.

This work was done by Otis R. Walton and Scott M. Johnson of Grainflow Dynamics, Inc. for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18403-1.

Hidden Statistics Approach to Quantum Simulations

This dynamic system could help in building quantum computers.

NASA's Jet Propulsion Laboratory, Pasadena, California

Recent advances in quantum information theory have inspired an explosion of interest in new quantum algorithms for solving hard computational (quantum and non-quantum) problems. The basic principle of quantum computation is that the quantum properties can be used to represent structure data, and that quantum mechanisms can be devised and built to perform operations with this data. Three basic “non-classical” properties of quantum mechanics — superposition, entanglement, and direct-product decomposability — were main reasons for optimism about capabilities of quantum computers that promised simultaneous processing of large massifs of highly correlated data. Unfortunately, these advantages of quantum mechanics came with a high price. One major problem is keeping the components of the computer in a coherent state, as the slightest interaction with the external world would cause the system to decohere. That is why the hardware implementation of a quantum computer is still unsolved.

The basic idea of this work is to create a new kind of dynamical system that would preserve the main three properties of quantum physics — superposition, entanglement, and direct-product decomposability — while allowing one to measure its state variables using classical methods. In other words, such a system would reinforce the advantages and minimize limitations of both quantum and classical aspects.

Based upon a concept of hidden statistics, a new kind of dynamical system for simulation of Schrödinger equation is proposed. The system represents a modified Madelung version of Schrödinger equation. It preserves superposition, entanglement, and direct-product decomposability while allowing one to measure its state variables using classical methods. Such an optimal combination of characteristics is a perfect match for simulating quantum systems. The model includes a transitional component of quantum potential (that has been overlooked in previous treatment of the Madelung equation). The role of the transitional potential is to provide a jump from a deterministic state to a random state with prescribed probability density. This jump is triggered by blow-up instability due to violation of Lipschitz condition generated by the quantum potential. As a result, the dynamics attains quantum properties on a classical scale. The model can be implemented physically as an analog VLSI-based (very-large-scale integration-based) computer, or numerically on a digital computer.

This work opens a way of developing fundamentally new algorithms for quantum simulations of exponentially complex problems that expand NASA capabilities in conducting space activities. It has been illustrated that the complexity of simulations of particle interaction can be reduced from an exponential one to a polynomial one.

This work was done by Michail Zak of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-47158

Reconstituted Three-Dimensional Interactive Imaging

Lyndon B. Johnson Space Center, Houston, Texas

A method combines two-dimensional images, enhancing the images as well as rendering a 3D, enhanced, interactive computer image or visual model. Any advanced compiler can be used in conjunction with any graphics library package for this method, which is intended to take digitized images and virtually stack them so that they can be interactively viewed as a set of slices. This innovation can take multiple image sources (film or digital) and create a “transparent” image with higher densities in the image being less transparent. The images are then stacked such that an apparent 3D object is created in virtual space for interactive review of the set of images.

This innovation can be used with any application where 3D images are taken as slices of a larger object. These could include machines, materials for inspection, geological objects, or human scanning.

Illuminous values were stacked into planes with different transparency levels of tissues. These transparency levels can use multiple energy levels, such as density of CT scans or radioactive density. A desktop computer with enough video memory to produce the image is capable of this work. The memory changes with the size and resolution of the desired images to be stacked and viewed.

This work was done by Joseph Hamilton, Theodore Foley, and Thomas Duncavage of Johnson Space Center and Terrence Mayes of Barrios Technology. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-23860-1