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Vizualizing 3D data

Scientific data visualization is one of the active areas in computer graphics lately. Special purpose graphics hardware and higher speeds of central processors are making it possible for researchers to visualize three-dimensional data in ways which were undreamt of ten years ago. The concept of visualizing data is not, of course, new. We are familiar with the graphical representation of functions of one variable or experimental data relating two parameters. However, if the functions or data depict relationships between three or more variables, then the modern tools of computer graphics become inevitable both for representing and visualizing them. These tools help us understand and visually clarify the relationships inherent in data. The last word on these tools is yet to be said and research is being carried out for faster algorithms and systems and better user-interfaces. The goal is nothing short of ushering in virtual reality over the graphic screen.

Practically no field of science and technology is exempt from the need to process and subsequently visualize large masses of data. Specific areas where the needs are more active include computational fluid-dynamics, molecular modelling, medical imaging and 4D mathematics. In physics and chemistry there is the need for visualizing field intensities and phase spaces.

One basic method of visualizing three-dimensional data is the explicit construction of what are known as isovalue surfaces. Conceptually, this method is the extension of the approach to construct 'isotherms' over a two-dimensional temperature field, for the case of three-dimensional data. Alternatively one can bypass the construction of an explicit surface but obtain an equivalent screen image by means of ray-tracing. The second approach, more favoured in the case of fuzzy and noisy data is preferred in the area of medical imaging, called 'volume rendering', by Marc Levoy, the originator of this approach, it has become a versatile tool for visualization over the last few years.

N. Ramesh and G. Athithan report (**page 252**) the details of their version of the volume rendering approach in an article in this issue. To test their implementation, they use two sets of volumetric data. The first set consists of probability density functions of the electron in a hydrogen atom while the second is computer-generated by means of methods to construct fractal data sets. The volume rendered probability density functions are shown from a non-standard viewpoint. The images of the volumetric fractal data sets come through as stellar clouds, as the authors claim. They also report the computation times involved in rendering these images, which justify the search for faster algorithms and systems. Solution for such a search, based on parallel computing is one possibility as is the development of special purpose hardware implementing the ray-tracing alogrithm.

Regeneration of plants

Ever since Cocking's discovery of the enzymatic technique for the isolation of protoplast, protoplast technology has come to stay as an important tool for the genetic manipulation of plants. It has found extensive use in induction of genetic variability and development of new genotypes for specific crop improvement programmes. However, an important constraint in the complete exploitation of this technique has been the frequent failure to obtain regeneration of plants from the protoplasts, particularly so, from the monocots (cereals) and tree species. For example, in rice, though a number of workers have reported stable transformations, transgenic plants are hard to obtain because of the lack of regeneration. This has prompted several workers to use innovative and novel culture techniques in an effort to obtain successful regeneration of plants from the protoplasts. Kyozuka and his co-workers from the Plantech Research Institute, Japan, pioneered one such technique, called the 'nurse-cell culture' method. In this method, rice protoplasts cultured along with cell suspensions of the same species (and sometimes others) were found to divide and form callus from which regenerants could be obtained. Obviously, the cell suspensions behaved as 'nurse-cells' and induced the protoplasts to divide.

On **page 257**, Reena Timothy and S. R. Sree Rangasamy present a simple protocol for the efficient regeneration of protoplasts of *Oryza sativa* subsp. *indica*. Isolated protoplasts of the widely cultivated variety, IR 50, were subjected to heat shock and layered over a semi-solid medium containing mixtures of suspension cells from rice varieties Norin-6, Norin-8, IR 50 and from a minor millet, *Paspalum serobiculatum*. In less than six weeks, the *indica* protoplasts divided and formed microcalli from which fertile plants could be regenerated. Their technique called 'feeder-layer', a modification of the 'nurse-cell culture' method of Kyozuka's, opens up the door for work on genetic manipulation of *indica* rice, an important crop of the Indian subcontinent.