REVIEW OF RECENT RESULTS ON EXCURSION SET MODELS

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ABSTRACT

Many images consist of two or more “phases”, where a phase is a collection of homogeneous zones. For example, the phases may represent the presence of different sulphides in an ore sample. Frequently, these phases exhibit very little structure, though all connected components of a given phase may be similar in some sense. As a consequence, random set models are commonly used to model such images. The Boolean model and models derived from the Boolean model are often chosen. An alternative approach to modelling such images is to use the excursion sets of random fields to model each phase. In this paper, the properties of excursion sets will be firstly discussed in terms of modelling binary images. Ways of extending these models to multi-phase images will then be explored. A desirable feature of any model is to be able to fit it to data reasonably well. Different methods for fitting random set models based on excursion sets will be presented and some of the difficulties with these methods will be discussed.

Keywords: excursion set, model fitting, random field, texture modelling.
INTERGRANULE FUSION IN RAT PARS INTERMEDIA CELLS

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ABSTRACT

Using electron microscopy, we studied the morphology of secretory granules in rat pars intermedia cells. We found figures of apparent intergranule fusion, characterized by a tight association of two granules. The fusion was detected in around 2% of all measured granules, indicating a low occurrence of intergranule fusion. To study whether intergranule fusion affects the distribution of granule diameters a simple probabilistic model was developed. It is based on the theory that larger granules are formed by fusion of two or more spherical granules of fixed size, and that the surface of a newly formed granule is equal to the sum of fused granule membranes. The model accounts for the bias on granule diameter measurements due to sectioning of granules. Although the electron microscopy data strongly indicates the existence of intergranule fusion in rat melanotrophs, this process as modelled in the present work does not contribute to the granule diameter distribution significantly. It is likely that in addition to the fusion of larger granules, other processes, such as fusion of microvesicles, may affect the distribution of granule diameters.

Keywords: intergranule fusion, melanotrophs, probabilistic model, rat, secretory granules, stereology.
MORPHOLOGICAL GRANULOMETRIC ANALYSIS OF SEDIMENT IMAGES

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ABSTRACT

Sediments are routinely analyzed in terms of the sizing characteristics of the grains of which they are composed. Via sieving methods, the grains are separated and a weight-based size distribution constructed. Various moment parameters are computed from the size distribution and these serve as sediment characteristics. This paper examines the feasibility of a fully electronic granularity analysis using digital image processing. The study uses a random model of three-dimensional grains in conjunction with the morphological method of granulometric size distributions. The random model is constructed to simulate sand, silt, and clay particle distributions. Owing to the impossibility of perfectly sifting small grains so that they do not touch, the model is used in both disjoint and non-disjoint modes, and watershed segmentation is applied in the non-disjoint model. The image-based granulometric size distributions are transformed so that they take into account the necessity to view sediment fractions at different magnifications and in different frames. Gray-scale granulometric moments are then computed using both ordinary and reconstructive granulometries. The resulting moments are then compared to moments found from real grains in seven different sediments using standard weight-based size distributions.

Keywords: granulometry, random model, sedimentology, size distributions.
PREDICTION OF THE EXTREMAL SHAPE FACTOR OF SPHEROIDAL PARTICLES

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ABSTRACT

In the stereological unfolding problem for spheroidal particles the extremal shape factor is predicted. The theory of extreme values has been used to show that extremes of the planar shape factor of particle sections tend to the same limit distribution as extremes of the original shape factor for both the conditional and marginal distribution. Attention is then paid to the extreme shape factor conditioned by the particle size. Normalizing constants are evaluated for a parametric model and the numerical procedure is tested on real data from metallography.

Keywords: extremal shape factor, spheroidal particles, unfolding.
SEQUENTIAL QUANTITATIVE ANALYSIS OF OVAL CELL PROLIFERATION IN THIOACETAMIDE TREATED RATS

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ABSTRACT

Oval cells are the progeny of facultative stem cells found in the periportal areas in response to liver injury in experimental animals and humans. The aims of this study were to describe the morphological, stereological and morphometric features of oval cells, and to compare them with those of bile duct cells and hepatocytes. It was also aimed to study the fate of oval cells by morphological and morphometric criteria. Rats were given thioacetamide to induce liver injury. The livers from experimental and control groups were processed routinely and stereological and morphometric analysis assessed using a computer image analysis system. Eight morphometric parameters were assessed in oval cells, bile duct cells and hepatocytes from control and experimental rats. Mitoses were observed in both oval cells and hepatocytes. Stereological area fraction analysis indicated that necrosis reached its maximum extent at 30 hours followed by regeneration and almost complete restoration of liver cell parenchyma at 132 hours. Oval cell proliferation reached a peak at 48-52 hours but was not apparent at 132 hours. Morphometric findings have shown increases in the nuclear diameter and nuclear area of oval cells with changes in the roundness and contours ratios of the nuclear membrane. It is concluded from this study that in thioacetamide treated rats, the liver responds to injury by bile ductal proliferation in the periportal areas which, accompanied by hepatocyte regeneration, leads to restoration of the hepatic parenchyma. At a subcellular morphological level the nuclei of oval cells showed a progressive change to a hepatocyte phenotype from that of a normal biliary cell, suggesting the differentiation of these cells into hepatocytes.

Keywords: bile ducts, liver regeneration, oval cells, stem cell, thioacetamide, toxicopathology.
RECTILINEAR AND BROWNIAN MOTION FROM A RANDOM POINT IN A CONVEX REGION

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ABSTRACT

A particle is projected from a point $P$ in a subset $E$ of a convex region $H$ to a point $Q$ in a uniformly random direction. The probability that $Q$ lies in the interior of $H$ at time $t$ is obtained for two types of motion of the particle, rectilinear (i.e. straight-line) and Brownian. In the case of rectilinear motion, the first passage time through the boundary of $H$ is considered. Results are obtained in terms of the generalized overlap function for embedded bodies.

Keywords: Brownian motion, convex body, geometric probability, random ray.
A DISECTOR program is presented, offering the possibility to count particles by the disector or unbiased sampling brick principles as well as to apply the point-counting method needed for estimation of the particle volume density or mean particle volume. Three modes of counting, two semi-automatic and one automatic, are offered, allowing the user to choose the one most suitable for his image data. In a semi-automatic regime, the user marks and counts individual particles by a mouse during browsing through the stack of images. In the algorithm working in an automated mode, the role of a human operator is suppressed, assuming that segmented objects are available in individual levels. The settings of the point grid and 3-D probe can be tailored for each application. The DISECTOR program applications are shown on the examples of the estimation of the number and numerical density of mesophyll cells in a Norway spruce needle and the mean volume of tubular cells in a chick embryonic kidney.

Keywords: confocal microscopy, disector, point counting, stereology, unbiased sampling brick.
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