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作品名稱

Quantitative Analysis of Organism Growth Using Fractal Dimension Statistics

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ABSTRACT

Cultures of bacteria were analyzed using fractal geometry and statistics to provide a method for predicting organism growth, paving the way for a better design of treatment drugs. Images of three cultures of isolated *Bacillus subtilis* were taken at time intervals of two to three hours for eight days. The images were processed using the IDOLON program and quantitatively described using three statistical formulas: fractal dimension D, Renyi dimension and Hausdorff-Besicovitch dimension. The three variables were integrated to compute the *maximum of the distribution* and were used as coordinates for a 3-dimensional graph ***f***. A 2-dimensional graph ***g*** containing the *maximum of a distribution* under time analysis was also constructed. Topological properties of the graphs, including slope, direction and area were used to determine the interrelationship of the three fractal values. The two graphs, described as φ - : X -» P1 where X is the smooth algebraic assimilation of the four variables under time analysis, was extended using Java. A computer-aided prediction model of the graphs ***f*** and ***g*** were made which combined the topology of ***f*** and ***g*** at infinity. The computed fractal values showed the existence of a fractal pattern in the growth of *Bacillus subtilis* with fractal dimension ranging from 0.900 to 4.000, indicating a linear iteration. This was supported by the values of the Renyi dimension, which showed a horizontal growth pattern of the bacterial cultures, establishing the growth of the bacteria to be inclined to go towards the North East direction. There was consistency in the computed fractal values, maximum of distribution and topographical computations of all three cultures which also indicated the existence of a pattern of growth which could be extended to $t_{infinity}$, thereby allowing prediction of the direction and rate of growth of the bacterial colonies. The fractal patterns in the growth of bacteria, in this case *Bacillus subtilis*,

yielded the direction and rate of growth of the bacteria as shown by the analysis of the fractal patterns and statistical values, showing that the growth of harmful organisms can therefore be predicted, making it possible to improve on the design of drugs for the control of perilous cells. By preventing the growth of insidious cells, the potential effects of virulent organisms may be avoided, and treatment may be made more possible.

評語

This project attempts to link the pattern in growth of Bacillus subtilis with that of the fractal. Judging from the unprofessional expression “which combines the topology of f and g at infinity”and the unprofessional superposition of the “growth tree” with the colonies of Bacillus subtilis displayed in the poster, we see that a gap between the state of the knowledge and the sophistication required to mix the two concepts needs to be filled. This project needs further polishing.

This project deals with E. coli, which can cause serious food poisoning in humans. To be qualified in taking part in the science fair, the experimental study of such bacterium requires safety check by the Scientific Review Committee. Observing the regulations makes all involved in the fair free of worry.