The following is a list of abstracts and/or descriptions of presentations to be given.

ON DERIVING THE CHARACTERISTIC POLYNOMIAL OF A GRAPH

Milan Randic

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The characteristic polynomial of a graph is defined as det (Ix-A), where A is the adjacency matrix and I identity (unity) matrix. In 1971 Harary et al. summarized the situation stating that: "... the calculation of characteristic polynomials for graphs of any size is usually extremely tedious...". Difficulty is due to combinatorial character of the problem, the number of contributions (terms or subgraphs of interest) growing exponentially. A short review of advances in computation of the characteristic polynomials since 1971 will be given, including evaluation of the characteristic polynomial for large structures, of structures with pending bonds and on alternative form of the characteristic polynomials of interest in the problem of graph recognition. This will be followed with report on more recent work in which an approach based on an extension of the Cayley-Hamilton theorem has been developed. The approach leads to a collection of equations for the coefficients of the characteristic polynomial, the entries in these equations representing the count of random walks of different length for any pair of vertices in a graph. The search for the characteristic polynomial is here transformed in construction of equations, which involves matrix-vector multiplications and subsequent solution of system of linear equations. It thus appears that the approach is not only practical even for larger and complex structures, but that it is also very efficient and relatively simple.

ON CHARACTERIZATION OF ISOSPECTRAL GRAPHS

Wayne L. Woodworth

Drake University

Graphs which have an identical characteristic polynomial but are not isomorphic are known as isospectral (or cospectral). Some properties of isospectral graphs are known and several schemes of their construction have been outlined. Of considerable interest is to characterize isospectral graphs or discriminate among them using some additional information. Recently, using alternative form for the characteristic polynomials based instead of on x^k terms of suitably scaled Chebishev polynomials $L_n(x/2)$ it was possible to distinguish between isospectral graphs belonging to different "families" of structurally related graphs. Here a more general approach will be outlined. It is based on the concept of the system of characteristic equations for the coefficients of the characteristic polynomial. Numerous illustrations will be given of isospectral graphs and the corresponding systems of characteristic equations, which are different, even though the solution of such system of equations would produce the same result! The reason for the difference is that characteristic equations involve the count of random walks of different lengths among different pairs of vertices, and these are as a rule different even within isospectral structures. In rare instances of so called unusual random walks one may find for nonequivalent pairs of vertices a same count of random walks of any length. Such situation signals vertices which may be useful in construction of novel isospectral graphs.

FACTORING THE CHARACTERISTIC POLYNOMIALS FOR GRAPHS WITH SYMMETRY

Grant Izmirlian

Drake University

We will consider here graphs with some symmetry properties and will outline how recognition of the symmetry may help in deriving the form for the characteristic polynomial which is already in factored form. First we observe that in case of graphs (or structures) with symmetry, which is reflected in occurance of equivalent vertices, the number of different characteristic equations within the system of the equations for the coefficients of the characteristic polynomial is reduced. The number can be so small that one may even have fewer equations than unknown. However, this reduction in data is accompanied with indication of equivalent vertices. If one now uses suitable linear combination of vertices consistent with the symmetry of the structure the original adjacency matrix A will split into a number of block B along the principal diagonal. Each of these can now be considered separately and will lead to corresponding factor of the characteristic polynomial in an analogous way that in case of lack of symmetry adjacency matrix A leads to the whole characteristic polynomial. Few illustrations will be presented and brief outline of the computer program which generate the system of equations and the factors will be given.

HYPERSPACE--EXPLORING THE CONCEPT OF DIMENSION

George Kelley

Maharishi International University

The fourth dimension of Euclidean Space is examined. An expanded value of "Space" unfolds by studying space in terms of itself using the concept of dimension. Particular emphasis is placed on making these ideas accessible to non-professional audiences by relating the ideas to general principles of creativity and order in nature, as well as personal experience.

A FULLER VALUE OF GEOMETRY

George Kelley, Corey Vian, and Vedder Wright

Maharishi International University

Some of the mathematical ideas of R. Buckminster Fuller are examined as well of Fuller's use of these ideas in modeling structure in nature. Particular emphasis is placed on making these ideas accessible to non-professional audiences by relating the ideas to general principles of creativity and order in nature, as well as personal experience.

THE MUSICAL EXPERIENCE OF NUMBER

George Kelley and Thomas Stone

Maharishi International University

The intimacy of numerical and tonal relationships is examined. By integrating the study of tone and number, both the fields of mathematics and music are enriched. Particular emphasis is placed on making these

ideas accessible to non-professional audiences by relating the ideas to general principles of creativity and order in nature, as well as personal experience.

THE GEOMETRY OF COEFFICIENTS OF POWERS OF POLYNOMIALS

Stephen J. Willson

Iowa State University

Let q(s) and w(s) be nonzero polynomials in n variables $s_1, \ldots, s_n$ with coefficients in Z/2. We associate with them a compact subset X of R^{n+1} which describes, in a limiting sense, the locations of the coefficients 1 in w(s) $q^t(s)$ for large t. It turns out that X is independent of the choice of w(s). We discuss the geometry of X.

USING AN UNDERSTANDING OF CONSCIOUSNESS TO EXPLAIN THE EFFECTIVENESS OF MATHEMATICS IN THE SCIENCES

Catherine Gorini Wadsworth

Maharishi International University

Abstract mathematical constructions, often developed for their intrinsic mathematical interest, are often found to be essential for the expression of scientific theories. Eugene Wigner, Richard Hamming and others have regarded this effectiveness as "unreasonable." Do the objects of mathematics, constructed by the imagination and logical thinking of the mathematician, have anything to do with the real and concrete objects of physics? We argue first that mathematical objects are very real structures of the mind and then that there is a very intimate connection between the mental and the physical. On this basis, the effectivenes of mathematics in the sciences is evident and reasonable.

A REFINED PLATONIST PHILOSOPHY OF MATHEMATICS: MATHEMATICS AS THE INTELLECTUAL EXPRESSION OF THE STURCTURE OF PURE KNOWLEDGE

Eric W. Hart

Maharishi International University

Platonism is a philosophy according to which the subject matter of mathematics is a realm of real, non-spatial, non-mental, timeless objects. These objects are claimed to be independent of, yet accessible to, the human mind. An interesting and useful refinement of plantonism arises upon making the following two revisions:

1) The real, non-spatial, non-mental, timeless realm postulated by platonism exists not without but within. It is the field of pure consciousness which it is possible for the human mind to experience as the source of thought, the simplest form of one's awareness.
2) Rather than ideal objects, the subject matter of mathematics is the ideal structure, pattern, and order of this realm.

Mathematics, then, attempts to give intellectual expression to this inner reality of the structure of pure knowledge. The educational practicality of this philosophy will also be discussed.

A UBIQUITOUS PARTITION ON PERFECT SUBSETS OF R^n

Donald John Nicholson

Iowa State University

The Grunowix space is a subset of R^n that contains no nbds which are closed in R^n. Letting X be a subset of R^n which is dense in itself, an examination of the properties of the Grunowix space reveals that it is possible to construct a partition on X such that every nbd in X meets each element of the partition (a local partition) if the elements of the partition are Grunowix spaces. A general method is developed for partitioning R^n and certain of its perfect subsets. Finally, after examining connectivity properties of Grunowix spaces, the method is extended to all perfect subsets of R^n.

"AUTOMATA: A VIEW FROM FOUR PERSPECTIVES"

Michael H. Millar

University of Northern Iowa

A brief examination of the concept of a finite-state machine in various guises, and some curricular implications.