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A new method of analysis of movement of mechanical joints

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Abstract

We propose here a type of differential geometry to describe the movement of machine elements supported by moving points on planes and/or lines using the action of special orthogonal group SO(3). The method is expected to reduce the error not only in the movement itself but also the tangent of the movement. In the case of Jaw simulator, named Gysi simplex and is used widely among the dentists, our method simplifies the computation and obtained results with sufficiently high accuracy.

Estimation of muscle force and ground reaction force at equilibrium of lower limb

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Abstract

This paper is related to orthopaedic musculoskeletal system. Here we have considered the forces and moments acting on the muscles in comparison with ground reaction forces. This estimation will lead us to prescribe the rehabilitation exercises after injury and surgery.

Structural and Mathematical modeling of weight distribution through plantar arch

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Abstract

Normally foot-strains are depending on the following factors:

- Ligamentus strains are caused by joint malalignment resulting from stress i.e. due elongation of ligaments at the foot joint beyond the normal limits.
- Degeneration of structure due to uneven distribution of forces not through the proper place.
- Dislocation of complex components of foot and ankle bone structure.

Structure of normal foot which is free of pain is composed of:
1.Weight bearing points (a) heal; (b) ball of great toe; (c) ball of little toe;
2.Normal muscle structure balancing the force distribution.
3.Absence of contraction of muscles, ligaments etc beyond limits.

All the muscles and ligaments attached to the ankle joint are catenoidal and cylindrical in structure. So, amount of force absorbed by those can be determined by mathematical modeling on catenary and straight line. But there is some rotation in tarsal bone will ball cavity joint system with mostly translational force due to contraction and relaxation.

Thus we locate the cause of strain and applying the anti-torsional force or by relaxation process we can relief the pain on foot-strain.

Role of fluid mechanics in coronary blood flow

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Abstract

Clinicians are very much interested in coronary blood flow but unfortunately the fluid mechanics involved in it, gets least importance to them. We have mathematically worked out the fluid mechanics involved in coronary blood flow using physiological data. The various changes in physiological parameters which evolve during pathological disease processes when put into these mathematical formulae may yield vivid picture of the altered hemodymics under diseased conditions.

Mathematical remarks on structure of Japanese short poems

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Abstract

Since almost of all consonants are pronounced together with vowels in Japanese, the space S of the sound in Japanese is smaller than Indo-European language. The usage of the Chinese character helped and accelerated the tendency. Therefore it is natural that the correspondence in Japanese from the space of the meaning M into the space S has more multiple points, the words having the same sound but another meaning, than the case of Indo-European language. Thus Japanese may be said practicing to construct inverse image in space of M from given key information in space S, which might make possible to plant Haiku and/or Tanka, both the very short form poems, deep into Japanese culture. If we admit that it is necessary to reconstruct inverse image through the given multiple point, the nodes in topological sense, to recognize the higher dimensional existence as in topology, the short poems refined only to key information that corresponds to the nodes could give an image of profound truth.

Indo-foreign culture

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Abstract

India came into intimate contact with the Persians, the Egyptians, the Greeks, the Arobs, the Central Asians, South East Asians, the Chinese, the Japanese, the Mediterranean and the Continental people. It is no doubt that India was influnced by these countries. But the caltural basis of India was strong enough. The sourse of her strength was evidenced in her history, literature, arts and the vigour of thoughts and the versatile faculty of understanding.

In our lecture, we shall highlight international understanding and cultural exchange between India and some foreign. This may provide Avenues and the advantage, the development of Indo-Foreign relations.

The topology of four-manifolds

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Abstract

This article is an accessible introduction to the work of M. Freedman and S. Donaldson on 4-manifolds. Here we describe the classification of 4-manifolds by M. Freedman, in particular, the solution of the Poincare conjecture in dimension 4. We also describe the celebrated theorem of S. Donaldson which implies that the 4-dimensional Euclidean space $\mathbb{R}^4$ has another differential structure quite different from its standard differentiable structure. Of course there are many important aspects that are not discussed here.

C^* algebra of binomial distribution and its application

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Abstract

Let D denote the space of probabilistic distributions $f(t)$ in time t, that is, the time sequences of (idealized) frequency of a phenomenon. We introduce additive structure into D by $af + bg$ for nonnegative constants a,b so that a+b=1 and multiplicative structure f*g by their convolution. If $f(t)$, $g(t)$ corresponds to the cause $\{f\}$, $\{g\}$ of the real phenomena, respectively, then $af + bg$ may be understood to correspond to the phenomenon caused by a% of $\{f\}$, and b% of $\{g\}$, that is, $\{af + bg\} = a\{f\} + b\{g\}$ and similarly $\{f * g\}$ corresponds to the phenomenon caused by $\{g\}$ as a result of $\{f\}$. Thus we see that the C^* algebra of distributions corresponds well to the space of causes, which allows us to utilize them for the causal analysis. When we consider the subspace of D consisting of the binomial distributions B having the initial incubating period, the C^* algebra over B is represented by space of traditional Sugoroku games making itself fit well to analyze the life table and/or the spreading of the deceases.

Nanotechnology from the bottom-up

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Abstract

Present nanontechnological development documents a self-similar real structure of matter all the way down to the threshold where it enters our participatory interaction observation. Regardless of absolute size, this is - literally and by definition - at the atomic (that is, indivisible) level. Ongoing work reported at previous ISRAMA meetings has shown that also in a theoretical investigation, according to the recent pure logic Nilpotent Universal Rewrite System (NUCR) algorithm in a faithful morphogenetic version, classical Euclidean geometry with spherical and Platonic solid forms obeying the respective established Lie algebras materializes as the actual elementary particles and their spectroscopy. At the 2006 ISRAMA it was reported that the extra-nuclear distribution of the electron assumes a space-filling truncated octahedron outline, and hence provides the smallest self-similar nanotechnological building block, or geodetic interval, of the real worlds crystalline ground structure. Here it is shown that in the next steps of assembly, the electron modules may join as individual ions into molecular clusters or, compressed to each other fuse into atomic honeycombs of periodic table signature; i.e., directly appear just as they are.

Clifford Algebra and its application in science and engineering

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Abstract

Clifford number has been defined and the elementary operations have also been stated. Its areas of application in science and engineering are enumerated. The areas covered here are missile simulation, chemical technology, consciousness, quantum mechanics and computer graphics. A brief description of application with the respective procedure is also presented in each case.

FROM MESH TO MESH-FREE HERITAGE STUDY

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Abstract

Due to the complexity of the analytical methods for solving engineering, applied and industrial problems; most of researchers prefer numerical methods. Boundary element methods is an example for such numerical methods, and one can say since nearly 30 years ago, it became the most popular one. The present lecture is a heritage study of the boundary element methods, and its application to potential like problems. Cavitations around 2-D hydrofoil, was taken as a practical example in this study. Different NASA standard cross-sections are examined using a new proposed algorithm based on one of the boundary element methods.

FROM MESH-FREE TO WHERE? Development and Progress

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Abstract

In the past decade several mesh-less techniques have appeared, which are easier to implement ccontinuum problems with free moving boundaries and interfaces. Such problems were difficult to solve with classical techniques as FEM, FVM, FD, because the mesh requires severe modification at each time step. In the present lecture, an overview study for the mesh-free methods will be carried out. This study aims mainly to give the insight to this new branch of numerical methods, which still have a lot to do. In this study, a new Radial Basis Function (RBF) is introduced since it developed by the author since 2005 and its results was good compared with other functions.

Domination Number of some particular grid graphs

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Abstract

Let $\gamma(P_m \square\ C_n)$ denote the domination number of the Cylinder grid graph formed by the cartesion product of the graphs P_m, the path of length m, $m \geq 2$ and the graph C_n, the cycle of length n, $n \geq 3$. In this paper we propose methods to find the domination number of graphs of the form $P_m \square\ C_n$ with $m = 2, 3, 4$. The methods that are used to prove that results readily lead to algorithms for finding minimal dominating sets of the above mentioned graphs.

DNA and knots

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Abstract

Any knot K in S^3 can be regarded as an embedding of a circle into R^3. Thus a mathematical knot is a closed curve in three-dimensional space. This can be visualized as a closed loop of string. DNA is the genetic material of all cells, containing coded information about cellular molecules and processes. DNA consists of two polynucleotide strands twisted around each other in a double helix. Two knots are considered the same if one can be moved smoothly through space, without any cutting, so that it is identical to the second. Mathematical knots are represented by two-dimensional diagrams that can be thought of as the shadow cast by a three-dimensional knot. DNA can be visualized as a complicated knot that must be unknotted by enzymes in order for replication or transcription to occur. In this paper we establish some connections between mathematical knot theory and biology. By thinking of DNA as a knot, we can use knot theory to estimate how DNA is to unknot. This can help us estimate properties of the enzymes that unknot DNA.

Acute triangulations on the surfaces

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A *triangulation* of a 2-dimensional space means a collection of (full) triangles covering the space, such that the intersection of any two triangles is either empty or consists of a vertex or of an edge. A triangle is called *geodesic* if all its edges are *segments*, i.e., shortest paths between the corresponding vertices. We are interested only in *geodesic triangulations*, all the members of which are, by definition, geodesic triangles.

Our interest will be focused on triangulations which are *non-obtuse* or *acute*, which means that the angles of all appearing geodesic triangles are not larger than, respectively smaller than, $\pi/2$.

We started together with Hangan the investigation of acute triangulations of all Platonic surfaces, which are the surfaces of the five well-known Platonic solids.

For the regular tetrahedron and octahedron, their natural triangulation is optimal in the sense that it contains the smallest number of triangles. Among the remaining, nontrivial cases, only the cube was completely treated and got the following results.

Theorem 1 (in [1]). *The cube admits several acute triangulations with 24 triangles, and no acute triangulation with fewer triangles.*

Here we treat the cases of the regular icosahedron and dodecahedron. We regard our work as a small step towards a solution to the following problem first raised in [1]. We consider this problem very natural, and far from trivial.

Problem 1. Does there exist a number N such that every compact convex surface in $\mathbb{R}^3$ admits an acute triangulation with at most N triangles?

In [1] was formulated the following problem also.

Problem 2. Find the minimal number of triangles of acute triangulation of the Platonic surfaces in the nontrivial cases, i.e., for the surface of the cube, of the regular dodecahedron, and of the regular icosahedron.

We completely solved the minimal acute triangulation of the regular icosahedral surface, and got the partial results about the minimal acute triangulation of the dodecahedral case.

Theorem 2 (in [2]). *The regular icosahedron admits an acute triangulation with 12 triangles and no acute triangulation with less than 12 triangles.*

Theorem 3 (in [3]). *The dodecahedron admits an acute triangulation with 14 triangles and no acute triangulation with less than 12 triangles.*

In this talk we discuss acute trianbgulations of other flat surfaces, Möbius strip, torus, Klein bottle, also.

Theorem 4 (in [4]). *Any flat Möbius strip can be triangulated with at most 9 acute triangles, and this is the best possible bound.*

Theorem 5 (in [5]). *Every flat torus can be triangulated into 16 acute triangles.*

Theorem 6. *Every flat Klein bottle can be triangulated into 16 acute triangles.*

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GUHA METHOD FOR DATA MINING

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GUHA - General Unary Hypotheses Automaton - introduced in [1] and still developing, is a method of automatic generation of hypotheses based on empirical data, thus a method of data mining. GUHA is a kind of automated exploratory data analysis: it generates systematically hypotheses supported by the data.

GUHA is primary suitable for exploratory analysis of large data. The processed data form a rectangle matrix, where rows correspond to objects belonging to the sample and each column corresponds to one investigated variable. A typical data matrix processed by GUHA has hundreds or thousands of rows and tens of columns. Exploratory analysis means that there is no single specific hypothesis that should be tested by our data; rather, the aim is to get orientation in the domain of investigation, analyse the behaviour of chosen variables, interactions among them etc. Such inquiry is not blind but directed by some general direction of research. GUHA is not suitable for testing a single hypothesis: routine packages are good for this.

The GUHA method is based on well-defined first order logic containing generalized quantifiers on finite models. A GUHA procedure generates statements on association between complex Boolean attributes. These attributes are constructed from the predicates corresponding to the columns of the data matrix.

GUHA systematically creates all hypotheses interesting from the point of view of a given general problem and on the base of given data. This is the main principle: “all interesting hypotheses”. Clearly, this contains a dilemma: "all" means most possible, "only interesting" means "not too many". To cope with this dilemma, one may use different GUHA procedures and, having selected one, by fixing in various ways its numerous parameters.

GUHA procedures not only hypotheses relating one variable with another one, but expressing relations among single variables, pairs, triples, quadruples of variables etc.

GUHA offers hypotheses. Exploratory character implies that the hypotheses produced by the computer (numerous in number: typically tens or hundreds of hypotheses) are just supported by the data, not verified. You are assumed to use this offer as inspiration, and possibly select some few hypotheses for further testing.

A software implementation of GUHA is available freely from http://lispminer.vse.cz/

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