Abstracts

All contributions submitted to International Workshop on Global Analysis by March 18, 2004, are listed below in alphabetical order.

Contents

1 ABADOĞLU, Ender
Yeditepe University, TURKEY

A Diagram For Higher Order Linear Connections

In this work, a diagram for higher order linear connections is constructed. This diagram relates Spencer sequences, global gauge sequence, torsion sequence and a sequence for higher order torsion-free linear connections and related Bianchi identities as well. It is shown that the diagram is exact and commutative.

2 AKGÜL, Arzu and BAYRAMOV, Sadi
Kocaeli University, TURKEY

Fredholm Joint Spectrum for Families of Operators

The most convenient versions of the Taylor joint spectrum for tuples of operators generating a nilpotent Lie algebra were constructed by Feinshtein and Dosiyev. A remarkable feature of Feinshtein's spectrum is that it satisfies a natural polynomial spectral mapping theorem with respect to polynomials in noncommuting variables.

In this work, Fredholm joint spectrum of noncommuting operator family which generates nilpotent Lie algebra is defined and investigated some properties of it. Let $a = (a_1, ...a_n)$ be define an operators family on the Banach space X, $\lambda \in C^n$, $(a - \lambda) = (a_1 - \lambda_1, ..., a_n - \lambda_n)$ and $E(a)$ be the nilpotent Lie algebra generated by a in the algebra $L(X)$. $Kos(a, X)$ is used for the Kozsul complex generated by the $E(a)$ module X [2]. The Fredholm joint spectrum of a is defined to be the set $\sigma_F(a)$ of those $\lambda \in C^n$ for which the complex $Kos(a - \lambda, X)$ whose homology spaces are not of finite dimension. It is proved that $\sigma_F(a)$ is a compact set in C^n. Polynomial spectral mapping theorem with respect to polynomials in noncommuting variables is proved such that $P(\sigma_F(a)) \subset \sigma_F(P(a))$.

3 ALEKSEEVICH, Udaloy Valeriy and LEONIDOVICH, Sokolov Nikolay
Mission Control Center and Modeling of Central Scientific and Research Institute of Machinebuilding, RUSSIA

Statistical Research Technique of Perturbed Trajectories of Vehicles Motion in Atmosphere

Was offered the statistical method of the vehicle trajectories researches in an atmosphere. It was based with the theory of Markovian process. It was supposed, that the space vehicle is in the one of the beforehand conditions of a phase space. The vehicle probabilities in these conditions calculated with Focker-Plank-Kolmogorovs equations. The vehicle motion is the probabilities changes. The common analysis has shown, the obtained outcomes are differing no more 5% then with other known methods obtained.

4 ALTAY Sezgin and ÖZEN Füsun

İstanbul Technical University, TURKEY

Generalized Birecurrent Riemannian Manifold With Semi-symmetric Metric Connection

The Riemannian manifolds with semi-symmetric metric connection have been studied by various authors. The authors here studied the nature of the birecurrent Riemannian manifold that admits a semi-symmetric metric connection and it is found that such a manifold (M^n, g) is generalized conformally birecurrent.

In the last part, we give an example for these manifolds.

5 ALZABUT, Jehad

Çankaya University, TURKEY

Functionally Equivalent Impulsive Systems with Delays

In general, the possibility of reducing impulsive differential systems with delays into impulsive differential systems without delays in such away that they have in common almost all the periodic solutions is still ambiguous and even hard to carry out. However, in the case when the delays satisfy certain functional relations, this property becomes possible and could be achieved. In this paper, we introduce the definition of functional equivalence for impulsive differential systems with delays and present a series of consequences on the existence of periodic solutions of these systems . Moreover, some generalizations of the main results are obtained.

6 ASADA, Akira
Sinsyu University, JAPAN

Zeta-regularization and Calculus on Infinite Dimensional Spaces

In the calculus of infinite dimensional geometry and analysis,we often meet the problem of divergence. For example, div. of a vector function contains infinite sum, so may diverges. To overcome this difficulty, a systematic way of application ofzeta-regularization was proposed (Asada, A.: Regularized Calculus: An application of zeta-regularization to infinitedimensional geometry and analysis, to appear in Int. J. Geo. Meth. of Math. Physics). In this talk, taking mathematical justification of the appearence of Ray-Singer determinant in the calculation of Gaussian Path integral as the example, regularized calculus is explained

7 ASHYRALYEV, A.
Fatih University, TURKEY

Nonlocal Boundary Value Problems for PDE:Well-Posedness

The role played by coercive inequalities in the study of local boundary value problems for elliptic and parabolic differential equations is well known. In present paper we consider the nonlocal boundary value problems for elliptic and parabolic differential equations. The coercive inequalities for the solution of these nonlocal boundary value problems are presented.

8 BALAN, Vladimir
University Politehnica of Bucharest, ROMANIA

Variational Problems in the Geometrized First-order Jet Framework

In the framework of geometrized jet spaces of first order endowed with a Lagrange structure, is discussed the existence of Lagrangian canonic nonlinear connections. The Euler-Lagrange equations for certain Kronecker-type Lagrangian cases are derived, and extensions of the known results are provided.

For spaces endowed with Cartan and Berwald linear N-connections, are presented the special curves of the geometrized jet space (h-paths, v-paths, stationary curves and geodesics) which extend the minimal paths of Rieman-

nian geometry. For the case of vertical metric independent of fiber coordinates, the first two variations of energy and the extended Jacobi field equations are determined, emphasizing the presence of torsion and non-holonomic character of the framework.

9 BALEANU, Dumitru and DEFTERLİ, Özlem

Institute of Space Sciences, ROMANIA and Çankaya University, TURKEY

Killing-Yano Tensors And Surface Terms

Considering the given free Lagrangians with an appropriate surface term that contains the components of the angular momentum results new geometries were obtained.The corresponding Killing vectors, Killing-Yano tensors for the constructed manifolds were calculated.

10 BALEANU, Dumitru and AVKAR, Tansel

Institute of Space Sciences, ROMANIA and Çankaya University, TURKEY

Lagrangians With Linear Velocities Within Riemann-Liouville Fractional Derivatives

The fractional calculus is a name for the theory of integrals and derivatives of arbitrary order, which generalize the notions of n-fold integration and integer-order differentiation. Differential equations of fractional order appear in certain applied problems and in theoretical researches. In this report, first of all, some fundamental concepts are considered. Then, Lagrangians linear in velocities are analyzed using the fractional calculus and Euler-Lagrange equations are derived. Two examples are investigated in details, the explicit solutions of Euler-Lagrange equations are obtained and the recovery of the the classical results are discussed.

11 BAŞER, Ulviye

İstanbul Technical University, TURKEY

Delay-depended H_∞ Control Problem for Linear Neutral Systems

In this paper H_∞ control problem for a class of neutral systems with discrete and distributed time delays is considered. Delay-independent and

delay-depended sufficient conditions are provided for designing memoryless state-feedback controller which stabilizes uncertain neutral system under consideration and guarantees an H_∞-norm bound constraint on the disturbance attenuation for all admissible uncertainties and unknownn state delays. These conditions are written in terms of Linear Matrix inequalities (LMIs). Some numerical examples are given to illustrate the solution.

12 BAŞKAL, Sibel

Middle East Technical University, TURKEY

Killing-Yano Tensors of Order Two and Three for a Class of Generalized pp-wave Metrics

Killing-Yano tensors of order two and three and their corresponding Killing tensors are found for a sub-class of metrics admitting parallel null 1-planes. These metrics include a possible generalization of the pp-wave metric and the Siklos metric which is conformal to it. Radiative properties of those metrics are also investigated within this context.

13 BERKOVICH, L.M.

Samara State University, RUSSIA

Principles of Superposition of Solutions for Nonlinear Ordinary Differential Equations and Evolution Equations

We consider methods of a factorization and exact linearization for nonlinear nonautonomous ordinary differential equations (ODE). The class nonlinear autonomous ODE nth order, which will be transformed to a class of the linear equations with the help of changes of variables, is constructed. In this case general solution of the nonlinear ODE represents principles of a nonlinear superposition of solutions of the given nonlinear equation or corresponding linear ODE. We have constructed also new class of the nonlinear evolutionary equations of any order supposing representation through a factorization of nonlinear differential operators.

14 BORDONI, Manlio

Spectra Of Submersions

Let (M; g); (B; j) be two connected compact Riemannian manifolds without boundary and let $\pi : M \to B$ be a submersion. We investigate the relations between the spectra of the Laplace-Beltrami operators acting on functions defined respectively on M, B and on the fibers $F_b = \pi^{-1}(b),\ b \in B$

The problem was completely solved, via representation theory, by G. Besson and me, when the submersion is riemannian and the fibers are totally geodesic submanifolds of M. Namely, we gave an explicit method to compute the eigenvalues with multiplicities and the eigenfunctios of Δ_M by the ones of Δ_F (in this case all the fibers are isometric to a typical fiber F) and the ones of the horizontal Laplacian.

When the submersion is Riemannian and the fibers are minimal submanifolds of M, one get the following estimates: for any integer N, the spectra of Δ_M and Δ_B are related by

$$\lambda_N(\Delta_M) \geq \frac{1}{8(p+1)^2}\lambda_{k+1}(\Delta_B)$$

$$\sum_{i=1}^{N}\lambda_i(\Delta_M) \geq \sum_{j=1}^{k}\lambda_j(\Delta_B)\frac{k}{8(p+1)}\lambda_{k+1}(\Delta_B)$$

where p is the rank of the subspace spanned by the N first eigenfunctions of Δ_M and where k is the integer part of $\frac{N}{p+1}$. Moreover, we prove that the resolvent operator $(\Delta_M + \lambda)^{-1}$ and the heat operator $e^{-t\Delta_M}$ dominate $(\Delta_B + \lambda)^{-1}$ and $e^{-t\Delta_B}$ respectively.

I finish with some recent results concerning Riemannian submersions with basic mean curvature vector field and almost-Riemannian submersions.

15 CAMCI, Uğur

Çanakkale Onsekiz Mart University, TURKEY

Collineations of (2+1)-Dimensional Friedmann-Robertson-Walker Spacetimes

Conformal Killing and Ricci collineation equations for (2+1)-dimensional Friedmann-Robertson-Walker (FRW) spacetimes are solved. These spacetimes are classified according to their Ricci conformal collineations (RCCs). In the non-degenerate and degenerate cases of the Ricci tensor (the cases $det(R_{ab}) \neq 0$ and $det(R_{ab}) = 0$, respectively), the general forms of the vector fields generating RCCs are obtained. When the Ricci tensor is degenerate, the special cases are classified and it is shown that there are many cases of RCCs with infinite degrees of freedom. Furthermore, it is found that when

the Ricci tensor is non-degenerate, the group of RCCs is finite-dimensional, and we have always 10-parameter group of RCCs which is the maximal possible dimension for three-dimensional spacetime manifold. The results obtained are compared with conformal Killing vectors.

16 CERVEN, Erik

Space-Time Dimensionality of Plain Physical Observation

A local Euclidean reference frame, which forms the basis of physical observations, may be defined by reference to some space-like separated frame, in which case a constrained validity of the closure axiom may be implied. For instance, the inverse of the x_1 component of the four-velocity may be Lorenz-transformed to an Euclidean reference frame defined around $\Delta t = 0$ whose spatial extension is limited by c. In this geometry, local observations of radial increments are made perpendicular to an angular velocity in a space-like separated frame. The space-time dimensionality of this system is further investigated. Interesting applications seem to be contracting three dimensions on a cosmological scale to a single axis of observation, and the Bohr atom

17 CHOUIKHA, A. Raouf

University of Paris, FRANCE

Some Properties of Pseudo-cylindric Metrics

Let the product Riemannian manifold $(S^1 \times S^{n-1}, dt^2 + d\xi^2)$, where S^1 is the circle of length T and (S^n, g_0) is the standard sphere. It is well known that the number of Yamabe metrics is finite in the conformal class of the Riemannian product metric $[dt^2+d\xi^2]$. These metrics called pseudo-cylindric metrics have a harmonic curvature and a parallel Ricci tensor unless the cylindric metric. We also examine the curvature of the asymptotic pseudo-cylindric metrics which are complete Yamabe metrics on $S^n - \Lambda_k$, where Λ_k is a finite set of k points in S^n, and $k \geq 2$. For all these metrics their Ricci tensors are non parallel except for the cylindric one.

18 ČOMIĆ, Irena

Faculty of Technical Sciences, SERBIA and MONTENEGRO

The Einstein-Yang-Mills Equations in Gauge Spaces of Order k

In the $(k+1)n$ dimensional space P, where the transformation group is given by

$$y^{0a'} = y^{0a'}(y^{0a}), \quad y^{1a'} = y^{1a'}(y^{0a}, y^{1a}), \quad \ldots, \quad y^{ka'} = y^{ka'}(y^{0a}, y^{1a}, \ldots, y^{ka})$$

the adapted basis in tangent and its dual space is constructed.

The Einstein-Yang-Mills equations which give the extreme value of integral of action

$$I(\phi) = \int_{\Omega} \sqrt{g} L(\phi, \partial_{0a}\phi, \partial_{1a}\phi, \ldots, \partial_{ka}\phi) d\omega$$

(L is Lagrangian, g is the determinant of the metric tensor) are determined.

19 CZUDKOVÁ, Lenka

Masaryk University Brno, CZECH REPUBLIC

Variational Non-holonomic Systems in Physics

Within the variational physical theories constrained systems are frequently studied. However, only the theory of holonomic constraints is satisfactorily elaborated. Recently, the new geometrical theory of first order mechanical systems with non-holonomic constraints was developed by Krupková and the corresponding reduced second order equations of motion were derived. The new concept of variationality of non-holonomic systems was introduced and the corresponding conditions of variationality (called the constraint Helmholtz conditions) for reduced equations were obtained (Krupková and Musilová).

In this contribution the results of these theories are applied to physics. Some appropriate situations (a relativistic particle, a system with Stokes frictional force etc.) are studied. The constraint Helmholtz conditions are examined under the influence of concrete choices of constraints and the corresponding constraint forces are obtained.

20 DE, U. C.

On Weakly Symmetric Structures On A Riemannian Manifold

The study of weakly symmetric and weakly projective symmetric manifold were initiated by Tamassy and Binh in 1989.
Later on several authors studied weakly symmetric Riemannian manifold and analogous structures, viz. Weakly Ricci symmetric, weakly projective symmetric and weakly conformally symmetric Riemannian manifolds. At first we cited examples of weakly symmetric Riemannian manifolds. Next we present a brief survey of results on weakly symmetric structures on a Riemannian manifold and some applications in the theory of relativity.
Among others it is proved that a conformally flat weakly Ricci symmetric manifold is the Robertson-walker space-time.

21 DİNÇ, Erdal, ÖZDEMR Abdil, BALEANU Dumitru

Ankara University, Sakarya University, TURKEY and Institute of Space Sciences, ROMANIA

Mathematical Chemometric Algorithms and its Application to the Analytical Chemistry

Mathematical chemometric algorithms were applied to simultaneous resolution of the chemical data obtained in complex mixtures. These mathematical procedures are based on the decomposition of absorbance and concentration data. The mathematical validation of the obtained chemometric calibrations were carried out by using the analytical data obtained from synthetic and real chemical samples. A good agreement between the developed mathematical calibrations was reported according the experimental results of multi-component mixture samples.

22 ERDEM, Sadettin

Süleyman Demirel University, TURKEY

Constancy of Some Maps into Certain Metric (para) **f** ***-manifolds***

For a decade, geometers have been considering maps between metric (para) f-manifolds in connection with their holomorphicity and harmonicity. Clearly constancy and non-constancy of such maps are vitally important. Thus, some results are already provided by some geometers (Duggal, K.

L.; Ianus, S.; Pastore, A. M and Gherghe, C.) along this line under some conditions on the map and the manifolds involved. In this work, we have given a constancy result with some considerable improvments to the ones given earlier: *i*) All the conditions on the domain manifold are removed and that it is simply taken to be a smooth manifold. *ii*) The conditions imposed on the target manifold are relaxed considerably and consequently constancy results are provided for much wider range of manifolds on the target.

23 ESMER, Göksel Daylan

İstanbul University, TURKEY

Horizons and Geodesics of Black Ellipsoids with Anholonomic Conformal Symmetries

The horizon and geodesic structure of static configurations generated by anisotropic conformal transforms of the Schwarzschild metric is analyzed. We construct the maximal analytic extension of such off–diagonal vacuum metrics and conclude that for small deformations there are different classes of vacuum solutions of the Einstein equations describing "black ellipsoid" objects. This is possible because, in general, for off–diagonal metrics with deformed non–spherical symmetries and associated anholonomic frames the conditions of the uniqueness black hole theorems do not hold.

24 ETESI, Gábor

Budapest University of Technology and Economics, HUNGARY

On the Construction of L^2 Harmonic Forms over Gravitational Instantons

Recently there has been some interest in understanding the L^2 cohomology of gravitational instantons from both physical and mathematical point of view. A gravitational instanton is an open, complete Riemannian 4-manifold whose curvature is self-dual and satisfies Einstein's equation with appropriate boundary condition in infinity. Most of these spaces are hyper-Kähler manifolds.

Regarding an L^2 harmonic 2-form as the curvature of a reducible self-dual $SU(2)$ connection of finite energy we construct these forms explicitly in case of Gibbons–Hawking spaces which are A_k or D_k ALE gravitational instantons. Then via twistor theory we extend our method to construct the

L^2 cohomology of the recently investigated new D_k ALF type gravitational instantons of Cherkis–Hitchin–Kapustin.

25 FABRITIIS, Chiara de

Universita' Politecnica delle Marche, ITALY

Composition Operators on Generalized Bergman Spaces

Recently, composition operators on spaces of holomorphic functions have been widely investigated by several authors (among others Bourdon, Cowen, MacCluer, Shapiro). In the present talk we study a class of Hilbert spaces of analytic functions on the punctured plane, namely the spaces of holomorphic functions which are square integrable with respect to a given weight (the so-called generalized Bergmann spaces). We investigate the structure of such spaces and we determine in which cases they are finite-dimensional. Moreover we study which are the composition operators acting on generalized Bergman spaces, with a particular attention to the action of S^1 on these spaces, and we give a classification of their cyclicity and hypercyclicity properties.

26 GERDJIKOV, V.S. and GRAHOVSKI, G.G.

Institute for Nuclear Research and Nuclear Energy, BULGARIA

On the Multi-component NLS Type Models and Their Gauge Equivalent

The fundamental properties of the multi-component nonlinear Schrödinger (NLS) type models related to semi-simple Lie algebra $\mathfrak{g}$

$$\begin{aligned} L(\lambda)\psi(x,t,\lambda) &\equiv \left(i\frac{d}{dx}+q(x,t)-\lambda J\right)\psi(x,t,\lambda)=0, \\ M(\lambda)\psi(x,t,\lambda) &\equiv \end{aligned}$$

$$\left(i\tfrac{d}{dt}-\pi_0\left([q,\mathrm{ad}_J^{-1}q_x]\right)+2i\mathrm{ad}_J^{-1}q_x(x,t)+2\lambda q(x,t)-2\lambda^2 J\right)\psi(x,t,\lambda) \;=\; 0$$

,

and their gauge equivalent Heisenberg ferromagnet type equations

$$\begin{aligned} \tilde{L}\tilde{\psi}(x,t,\lambda) &\equiv \left(i\frac{d}{dx}-\lambda\mathcal{S}(x,t)\right)\tilde{\psi}(x,t,\lambda)=0, \\ \tilde{M}\tilde{\psi}(x,t,\lambda) &\equiv \left(i\frac{d}{dt}-2i\lambda\mathrm{ad}_{\mathcal{S}}^{-1}\mathcal{S}_x-2\lambda^2\mathcal{S}\right)\tilde{\psi}(x,t,\lambda)=0, \end{aligned}$$

are analyzed. Here J is a **non-regular** element of the corresponding Cartan subalgebra $\mathfrak{h}$ (this means that the the kernel of the operator ad_J is non-commutative one); $q(x,t) \in \mathfrak{g}\backslash\mathfrak{g}_J$; π_0 is the projector onto $\mathfrak{g}_J = \ker(\mathrm{ad}_J)$; $\lambda \in \mathbb{C}$ is a spectral parameter and

$\tilde{\psi}(x,t,\lambda) = g^{-1}(x,t)\psi(x,t,\lambda), \quad \mathcal{S}(x,t) \equiv \mathrm{Ad}_g \cdot J = g^{-1}(x,t)Jg(x,t)$

$g(x,t) = \psi(x,t,\lambda = 0)$.

We extend our approach in order to implement additional reductions of these systems. To this end we first describe the scattering data properties of the relevant Lax operator L which in turn determine the spectra of the corresponding recursion operator Λ. Using the expansions over the eigenfunctions of Λ (so-called "squared solutions") we are able to describe: a) the class of all integrable equations related to L; b) their class of local integrals of motion; c) their hierarchy of Hamiltonian structures.

The results are illustrated by specific examples of NLS type systems and their gauge equivalent related to the $so(5)$-algebra.

27 GREBENYUK, Maryna

UKRAINE

Normals of the Equipping Distributions for Three-component Distribution in the Affine Space

The geometrical objects, which are quasitensors of the second order of the three- component distribution, have been constructed. These objects determine the normals of the first kind of the equipping M-distribution and hyperdistribution by the inner invariant method in the second and third differential neighbor- hoods of the forming element of the three-component distribution. It has been proved that the normals of the second kind of the equipping M-distribution and hyperdistribution for the three-component distribution are defined by an inner way in the second differential neighborhood. The results of the research can be applied to a general theory of distributions in multidimensional spaces.

28 GRECU, Dan and VISINESCU, Anca

National Institute for Physics and Nuclear Engineering, ROMANIA

Crossover Behavior Between KdV And mKdV Equations In A Cold Plasma With Negative Ions

It is well known that the KdV equation describes the behavior of ion-acoustic waves in a cold plasma. In the presence of negative ions, if their concentration satisfies a certain condition (critical concentration) the relevant equation is the modified KdV equation. The transition between these two regimes is studied from several point of view. The multiple scales analysis is extended to higher order and the role played by the next equations in the corresponding hierarchies KdV and mKdV is discussed.

29 GUSEINOV, Gusein Sh.
Atılım University, TURKEY

Discrete Variational Calculus

The discrete calculus of variations for sums will be treated, including the Euler-Lagrange difference equation, transversality conditions, the Legendre necessary condition for a local extremum, and some sufficient conditions.

30 HALL, Graham
University of Aberdeen, UNITED KINGDOM

Symmetries and Orbit Theory in 4-dimensional Lorentz Manifolds

In a 4-dimensional Lorentz Manifold (M, g), symmetries are often described by a finite dimensional Lie algebra A of vector fields. The associated distribution $\Delta : m \to \Delta(m) = \{X(m) : X \in A\}$ is integrable with a natural orbit structure generated by the local flows of members of A. Usually the symmetries involved are the symmetries or conformal symmetries of the Lorentz metric g or the affine or projective symmetries of its associated Levi-Civita connection. (Other symmetries may also be considered but then A may not be finite-dimensional). In studying the orbits of A, concepts of stability and dimensional stability will be introduced. A general review of the theory will be given and, in particular, the application to the study of symmetry in general relativity theory.

31 HAYDARGİL Derya, KOÇ Ramazan and TÜTÜNCÜLER Hayriye
Gaziantep University, TURKEY

Identification Of $E \otimes \beta$ Jahn-Teller Systems and Their Finite Group Invariance

In this work we discuss finite group invariance of the Jaynes-Cummings Hamiltonian. We show Jaynes-Cummings Hamiltonian without rotating wave approximation is identical to the $E \otimes \beta$ Jahn-Teller Hamiltonian. We also obtain the the exact solution of Jaynes-Cummings Hamiltonian without rotating wave approximation, and modified Jaynes-Cummings Hamiltonian.

32 JENSEN, Cathrine Vembre
University of Tromsoe, NORWAY

Ordinary Differential Equations: Decomposing and Solving Equations in Terms of Irreducible Representations of Symmetry Agebras.

Viewing linear ODEs as $C^\infty(\mathbb{R})$-modules with a derivation over $\frac{d}{dx}$ is appropriate for studying symmetry algebras of the equations. Modules, and hence equations, that possess a semisimple Lie algebra of symmetries are decomposable. In particular we shall see how equations with a $\mathfrak{sl}_2$ symmetry algebra decompose into modules isomorphic to symmetric products of a base rank two module corresponding to a second order equation, a model equation for $\mathfrak{sl}_2$. The model equations can be integrated directly, and knowing its solutions and the decomposition solves the original equation.

33 KASAP, Suat
Çankaya University, TURKEY

An Overview of Mean Field Theory in Combinatorial Optimization Problems

In the last two decades, there has been significant interest in using mean field theory coming from statistical physics in combinatorial optimization, neural networks, image processing, and engineering. This has led to the development of powerful optimization techniques such as neural networks (NNs), simulated annealing (SA), and mean field annealing (MFA). MFA

combines many characteristics of SA and NNs. MFA replaces the stochastic nature of SA with a set of deterministic equations named as mean field equations. The mean field equations depend on the energy function of the NNs and are solved at each temperature during the annealing process of SA. MFA advances to the optimal solution in a fundamentally different way than stochastic methods. The use of mean field techniques for the combinatorial optimization problems are reviewed extensively in this study.

34 KASAP, Suat
Çankaya University, TURKEY

Differential-Algebraic Equations in Primal Dual Interior Point Optimization Methods

Primal dual Interior Point Methods (IPMs) generate points that lie in the neighborhood of the central trajectory. The key ingredient of the primal dual IPMs is the parameterization of the central trajectory. A new approach to the parameterization of the central trajectory is presented. Instead of parameterizing the central trajectory by the barrier parameter, it is parameterized by the time by describing a continuous dynamical system. Specifically, a new update rule based on the solution of an ordinary differential equation for the barrier parameter of the primal dual IPMs is presented. The resulting ordinary differential equation combined with the first order Karush-Kuhn-Tucker conditions, which are algebraic equations, are called differential algebraic equations (DAEs). By solving DAEs, we find an optimal solution to the given problem.

35 KHADJIEV, D.
Karadeniz Technical University, TURKEY

The complete system of global integral and differential invariants for surfaces in Euclidean space

For the euclidean group $\epsilon(n)$ of motions of R^n, definitions of an $\epsilon(n)$-equivalence of surfaces and an euclidean type of a surface are introduced. All euclidean types of surfaces are described. The $\epsilon(n)$-equivalence of surfaces is reduced to the problem of the $\epsilon(n)$-equivalence of parametric surfaces. A generating system of the differential field of $\epsilon(n)$-invariant differential rational functions of parametric surfaces is described. Global conditions of the

$\epsilon(n)$-equivalence of surfaces are given in terms of the euclidean type of a surface and the generating differential invariants. Correlations between of the generating differential invariants are investigateded.

36 KORCÜK Eser, KOÇ Ramazan and TÜTÜNCÜLER Hayriye

Gaziantep University, TURKEY

Solution Of The $T \otimes t$ Jahn-Teller Hamiltonian

We consider the Hamiltonian that operates entirely within threefold degenerate electronic T state coupled to a five normal modes of vibration that spon on H irreducible representation. The $T \otimes t$ Jahn-Teller Hamiltonian has rotationally symmetry transformation of the group. In this paper, we will show how the Jahn-Teller interaction matrices are constructed for the icosehedral group using the symmetry properties. Then $T \otimes h$ matrix hamiltonian is used in the contex of the quasi exactly solvable spectral problems.

37 KOZMA, László

University of Debrecen, HUNGARY

Sub–Finslerian Geometry

In the talk first the notion and basic questions of sub–Finslerian geometry will be explained. A sub-Finslerian manifold is, roughly speaking, is manifold M which is equipped with a cone (or distribution) $D \subset TM$ and sub-Finslerian function $F : D \to R^+$ with some regularity conditions. This notion, initiated by C. López and E. Martínez in 2000, generalizes the notion of sub–Riemannian geometry, called also Carnot–Carathéodory theory. First we discuss how it is possible to introduce the parallelism, covariant derivations and geodesics in this circumstance. Then we show the relationships and the applicability of this new notion with control theory.

38 KRUPKA, Demeter

Palacky University, CZECH REPUBLIC

Global Variational Principles: Foundations And Current Problems

1. Variational functionals on fibered spaces
2. First variation and the Lepage forms, the Euler-Lagrange form
3. Higher variations
4. Invariant variational functionals, first theorem of E. Noether
5. Natural variational principles, second theorem of E. Noether
6. Variationally trivial Lagrangians
7. The inverse problem of the calculus of variations
8. The variational sequence
9. Lepage forms: Examples, generalizations
10. Invariant variational principles on principal fiber bundles
11. Energy-momentum tensors
12. Jets and contact elements

39 KRUPKOVA, Olga

Palacky University, CZECH REPUBLIC

The Geometry of Variational Equations

Recent developments in the geometric theory of variational differential equations will be presented. The following topics will be discussed:
1. Differential equations in jet bundles
2. Variational equations, necessary and sufficient conditions of variationality.
3. Variational ordinary differential equations: classification, structure of solutions, regular and singular variational problems.
4. Variational partial differential equations: regularity, Hamiltonian differential systems.
5. Methods of solutions of variational equations: symmetries and conservation laws, the Liouville and Hamilton-Jacobi method.

40 LÉANDRE, R

Universite de Nancy, FRANCE

White noise analysis, filtering equation and the index theorem for families.

Bismut has pointed out the relation between filtering theory and the index theorem for families. We give an interpretation of the heuristic expressions used by Bismut as an Hida distribution (by using Chen forms instead of Wiener chaos) with values in the space of L^2 forms of the loop space on the

basis manifold endowed with a convenient measure. The link with the Index theorem for families is keot as in the heuristic works of Bismut.

41 LYCHAGIN, Valentin
University of Tromso, NORWAY

Geometrical and Analytical Methods for the PDE's Solutions

The various notions of PDEs integrability shall be discussed. Constructive methods , old and new, for PDEs integration based on symmetries and differential invariants shall be proposed, and applications to some popular PDEs shall be shown.

42 MAKHALDIANI, Nugzar
Laboratory of Information Technologies, Joint Institute for Nuclear Research, RUSSIA

Nambu-Poisson Dynamics and Applications

After a short introduction in the Nambu-Poisson dynamics (NPD), some applications of NPD in the finite- as well as infinite-dimensional models are considered.

43 MANNO, Gianni
University of Lecce, ITALY

On the Geometry of the Geodesic Equation in the Jet of 1-dimensional Submanifolds

The geodesic equation $\mathcal{G}_\varrho$ in the jet of the trivial bundle $\varrho\colon E \times \mathbb{R} \to \mathbb{R}$ and the geodesic equation $\mathcal{G}$ in the jet of 1-dimensional submanifolds of E are taken into consideration. The equivalence of the higher approach to symmetries with the classical approach is proved, and a covering map between $\mathcal{G}_\varrho$ and $\mathcal{G}$ is discovered. The variationality of $\mathcal{G}$ is discussed.

44 MATSUMOTO, Koji
Yamagata University, JAPAN

Twisted Warped Product CR-submanifolds in Kaehler manifolds

Recently B.Y. Chen introduced two types of warped product CR-submanifold in Kaehler manifolds and he got a lot of interesting properties in this submanifold. In the present talk, we define twisted warped product CR-submanifolds in Kaehler manifolds. We prove several fundamental properties of these submanifolds and establish a general inequality for the length of the second fundamental form. Finally, we consider the equality case of this inequality.

45 MATSUYAMA, Yoshio
Chuo University, JAPAN

On Einstein Lagrangian Submanifold of a Complex Projective Space

In the present talk I would like to the parallelism of an Einstein minimal Lagrangian submanifold M of a complex projective space. We show that if M is complete, then M is parallel and M is one of the following conditions holds: a) M is totally geodesic, b) M is a finite Riemannian covering of a flat torus minimally embedded in a 2-dimensional complex projective space with parallel second fundamental form, c) M is an embedded submanifold congruent to the standard embedding of: symmetric spaces $SU(3)/SO(3)$, $SU(3)$, $SU(6)/Sp(3)$ or E_6/F_4 of rank 2 of dimensional 5, 8, 14, 26. Also I'd like to the parallelism of a compact Einstein complex submanifold of a complex projective space.

46 MATVEEV, Vladimir S.
Mathematisches Institut, GERMANY

Projective Lichnerowicz-Obata Conjecture

I will prove the following classical conjecture: Let a connected Lie group act on a complete Riemannian manifold by transfomations that take (unparameterized) geodesics to geodesics. Then, it acts by affine transformations, or the manifold can be covered by the round sphere.

The methods of proof came from geometric partial differential equation and integrable systems: if Lie group preserves geodesics, a certain system

of partial differential equations is fulfilled. We analyse this system with the help of integrable systems.

47 MESTDAG, Tom

Ghent University, BELGIUM

Generalized Connections and Affine Bundles

Connections are among the most important tools to study qualitative features of mechanical systems. In this talk, we will discuss generalized connections on affine bundles and show how they appear in the context of Lagrangian systems on affine Lie algebroids.

48 MONFORTE, Juan Cortes

University of Illinois Urbana-Champaign, USA

An Incursion into Optimal Control and Geometric Optimization

Optimal control and optimization problems are a widespread topic in several scientific disciplines and engineering applications. In the first part of this talk, we present a collection of results on optimal control theory from a geometric perspective. We pay particular attention to the consistency of the equations and the role of symmetry principles. In the second part, we focus on geometric optimization problems, i.e., optimization problems induced by geometric objects. We examine a class of disk-covering and sphere-packing problems, and investigate its relationship with robotic coordination algorithms. The technical approach relies on tools from Geometric Mechanics, Differential and Computational Geometry and Nonsmooth Analysis.

49 MUSLIH, Sami

Al-Azhar University, PALESTINE

On the Path Integral Quantization of Constrained Systems Based on Güler's and Batalin-Fradkin-Tyutin (BFT) methods

Constrained Hamiltonian systems are investigated by using Güler's method. Integration of a set of equations of motion and the action function is discussed. It is shown that the canonical path integral quantization is obtained

directly as an integration over the canonical phase-space coordinates without any need to enlarge the initial phase-space by introducing extra- unphysical variables as in the Batalin-Fradkin-Tyutin (BFT) method.

50 MYRZAKUL Kur., RAKHIMOV F.K., SERIKBAEV N.

Institute of Mathematics, KAZAKHSTAN

Differential Geometry of Surfaces and the Generalized Landau-Lifshitz Equations

The generalized multicomponent Landau-Lifshitz equation (GMLLE) is constructed. We discuss motion of surfaces, where the surfaces obey the Mainardi-Codazzi equation. We briefly outline two alternative ways to proceed and show some new results they lead to. In particular, the relation between the GMLLE and the Mainardi-Codazzi equation is established.

51 MYRZAKULOV R., RAHIMOV F.K., ZHUNUSSOV K.Kh.

Institute of Physics and Technology, KAZAKHSTAN

Geometry of Integrable Nonlinear Equations of Physics

In a geometrical framework, we establish the integrability of the two-dimensional Heisenberg spin chains. A unifying approach, based on the Heisenberg ferromagnetic spin chains, to the construction of integrable classes of curves and surfaces is discussed. We show that solitonic solutions of the classical spin chain can be classified in terms of some particular classical solutions of the string theory.

52 NICULESCU, Constantin P.

University of Craiova, ROMANIA

Convexity Inequalities and Applications

The starting point is the *Favard-Berwald inequality,* which asserts that

$$\frac{1}{n+1}\sup_{x\in K} f(x) \leq \frac{1}{|K|}\int_K f(x)\,dV$$

for every continuous concave function $f : K \to \mathbb{R}_+$ defined on an arbitrary compact convex subset $K \subset \mathbb{R}^n$, of positive volume $|K|$. Equivalently, the

volume of every conoid of base K and height $f(x)$ (for every $x \in K$) does not exceed the volume of the cylindroid of base K, bounded above by the hypersurface $v = f(u)$.

The aim of our talk is to discuss the significance of this result within Choquet's theory and to prove a number of extensions and refinements of it.

53 ÖZEN Füsun and ALTAY Sezgin
İstanbul Technical University, TURKEY

A Semi-symmetric Metric Connection on a Weakly Symmetric Riemannian Manifold

The object of this paper is to study a type of weakly symmetric Riemannian manifolds $(WS)_n$ admitting semi-symmetric metric connection. The notions of weakly symmetric and weakly projective symmetric spaces were introduced by L. Tamassy and Tran Quoc Binh.

But in this paper, $(WS)_n$ is invastigated and a reduction in $(WS)_n$ is obtained in a simpler form.

In the last part, we prove the existence of these manifolds by examples.

54 ÖZER, Mahmut
Zonguldak Karaelmas University, TURKEY

Relaxation Phenomena in the (in)activation Gates of the Voltage-gated Ion Channels

We previously proposed a method for the study of the relaxation phenomena in the activation and inactivation gates of ion channels present in the excitable membranes of neurons. In order to study the relaxation phenomena, the assumption is made that the activation and inactivation gate order parameters can be treated as fluxes and forces. In the present paper, we extend the previous model as including an ensemble of gating particles, and apply it for T-type calcium channel in thalamic relay neurons. It is found that kinetic equations are characterized by two relaxation times. The kinetic coefficients are determined for its empirical model. We also determine the kinetic coefficients of linear and nonlinear thermodynamic models for the same T-type calcium channel, and compare them with the empirical ones.

55 PAMUK, Serdal and GÜVEN, Aslıhan
Kocaeli University, TURKEY

Stability Analysis of the Steady-State Solution of a Mathematical Model in Tumor Angiogenesis

The stability of the steady-state solution of endothelial cell equation in a mathematical model for tumor angiogenesis is studied. It is proven mathematically that the steady-state solution is indeed the transition probability function $\tau(c_a, f)$. Trajectories near the critical point(s) are drawn, and the biological importance of the result is expressed briefly.

56 PEKŞEN, Ömer
Karadeniz Technical University, TURKEY

The Complete System of Global Integral and Differential Invariants for Centro-affine Curves

Let $GL(n, R)$ be the general linear group of $n \times n$ real matrices. Definitions of $GL(n, R)$-equivalence and the centro-affine type of curves are introduced. All possible centro-affine types are founded. For every centro affine type all invariant parametrizations of a curve are described. The problem of $GL(n, R)$-equivalence of curves is reduced to that of paths. A generating system of the differential field of invariant differential rational functions of a path is described. They can be viewed as centro-affine curvatures of a path. Global conditions of $GL(n, R)$-equivalence of curves are given in terms of the centro-affine type and the generating differential invariants. Independence of elements of the generating differential invariants is proved.

57 RABEI, Eqab M.
Mutah University, JORDAN

Hamilton-Jacobi Treatment of Lagrangians with Linear Velocities

A new approach for solving mechanical problems of Linear Lagrangian systems using the Hamilton-Jacobi formulation is proposed. The equations of motion are recovered from the action integral. It has been proved that there is no need to follow the consistency conditions of the Dirac approach.

58 RAKHIMOV A.A. and KELEŞ H.
Karadeniz Technical University, TURKEY

On the Fuzzy d-dimensional linear Spaces

Let N be a finite set with at least three points, L be a finite F-lattice (i.e. completely distributive lattice with an order-reversing involution $' : L \to L$) and L^N be a set of the all Fuzzy subsets of N. For a subfamily (so called *fuzzy lines*) $D \subset L^N$ the pair (N, D) is called *Fuzzy near-linear spaces* (FNLS) if it satisfies the following three conditions:

(NFLS-1) for all $x, y \in N$ there exists $d \in D$ such that $d(x) \wedge d(y) \neq \theta$;
(NFLS-2) for any $d \in D$ there exist $x, y \in N$ such that $d(x) \wedge d(y) \neq \theta$;
(NFLS-3) there exist $x, y, z \in N$ for all $d \in D$ holds $d(x) \wedge d(y) \wedge d(z) = \theta$.

In this work the difference between FNLS and traditional near-linear spaces (TNLS) is considered. In is known that, two distinct lines of TNLS intersect in at most one point and for two d_1, d_2 lines $d_1 \leq d_2$ implies $d_1 = d_2$. It is proved that these propositions for FNLS, general speaking, is not true. Moreover, the definitions of closure and independent sets, and basis of FNLS is given.

59 SAUNDERS, D. J.
Open University, Great Britain

Sprays and Cartan Projective Connections

Around 80 years ago, several authors (for instance H. Weyl, T.Y. Thomas, J. Douglas and J.H.C. Whitehead) studied the projective geometry of paths, using the methods of tensor calculus. The principal object of study was a spray, namely a homogeneous second-order differential equation, or more generally a projective equivalence class of sprays. At around the same time, E. Cartan studied the same topic from a different point of view, by imagining a projective space attached to a manifold, or, more generally, attached to a 'manifold of elements'; the infinitesimal 'glue' may be interpreted in modern language as a Cartan projective connection on a principal bundle. This talk describes the geometrical relationship between these two points of view.

60 SCHNEIDER, Baruch
İzmir University of Economics, TURKEY

Some Properties of the Cauchy-type Integral for the Moisil-Theodorescu System of Partial Differential Equations

The talk is based on joint results with M. Shapiro. In the talk it will be told about the analog of the Cauchy-type integral for the theory of Moisil-Theodorescu system of partial differential equations in case of a piece-wise Liapunov surface of integration. The main topics of the talk concern theorems which cover basic properties of that Cauchy-type integral: the Sokhotski-Plemelj theorem for it as well as the necessary and sufficient condition for the possibility to extend a given Holder function from such a surface up to a solution of Moisil-Theodorescu system of partial differential equations in a domain. Formula for the square of the singular Cauchy-type integral is given. The proofs of all these facts are based on intimate relations between the theory of Moisil-Theodorescu system of partial differential equations and some versions of quaternionic analysis.

61 SEDENKOVA, Jana
Tomas Bata University, CZECH REPUBLIC

A Generalization of Lepagean Forms in Mechanics

Generalization of Lepagean forms in mechanics is presented. The Euler-Lagrange operator for creating representatives of classes of forms in the first order variational sequences is used. The conditions to make a description when a given differential form is or is not Lepagean are presented. The canonical part of the Lepagean forms of degree k, where $1 \leq k \leq 4$, is introduced.

62 SENASHOV, S.I.
Sibirean State Aero-Space University, RUSSIA

Use Symmetries and Conservation Laws for Solution of Boundary Problems of PDE's Ideal Plasticity

For (PDE) of ideal plasticity were found symmetries and conservation laws. Conservation laws were used for solution of boundary problems for this equations. The symmetries of system 2-dimensional differential equa-

tions of ideal plasticity allow to transform its solutions to solutions of this system. From will known Prandtl's solution were constructed new analytical exact solution of 2-dimensional differential equations of ideal plasticity. The conservation laws were used for solution boundary problems for this equations.

63 SHARMA, Ajay

Community Science Centre Shimla, INDIA

The Origin of Generalised Mass-Energy Equation $\Delta E = Ac^2\Delta M$; Its Mathematical Justification and Application in General Physics and Cosmology

Einstein derived (in Sep 1905 paper), an equation that when light energy L is emitted its mass decreases (as mass is converted to energy) given by $\Delta m = L/c^2$, which is speculative origin of $\Delta E = c^2\Delta m$. The same derivation predicts that the mass of source must also INCREASE ($\Delta m = 0.0001523L/cv+L/c^2$) or remain the SAME ($\Delta m = 0$) when it emits light energy. Thus law of conservation of mass energy is contradicted. Consequently an alternate equation i.e. $\Delta E = Ac^2\Delta M$, has been purposely derived. It implies that energy emitted on annihilation of mass (or vice versa) can be equal, less and more than predicted by Einsteins equation. It explains the energy emitted (10^{45}J) in Gamma Ray Bursts ($0.1s - 100s$) with high value of A i.e. 2.57×10^{18}, similar is case of Quasars. $\Delta E = Ac^2\Delta M$, explains that mass of universe 10^{55} kg was created from dwindling amount of energy (10^{-444}J or less) with value of A 2.568×10^{-471} J or less. Whereas $E = \Delta mc^2$ predicts the mass of universe 10^{55}kg was originated from energy 9×10^{71} J

64 SHIMA, Kazunari

Saitama Institute of Technology, JAPAN

Nonlinear Supersymmetric General Relativity and Unity of Nature

A nonlinear supersymmetric general relativity theory(NLSUSY GRT) of Einstein-Hilbert(EH)-type is proposed by extending the geometrical arguments of Einstein general relativity theory(EGRT) on Riemann spacetime to new (SGM) spacetime posessing *locally* NL SUSY d.o.f, i.e. besides the ordinary SO(3,1) Minkowski coordinate x^a the SL(2C) Grassman coordinates

ψ for the coset space $\frac{superGL(4,R)}{GL(4,R)}$ turning subsequently to the NG fermion dynamical d.o.f. are attached at every curved spacetime point. The new action of NLSUSY GR is unstable and breaks spontaneously to EH action with matter. Some implications for the particle physics and the cosmology are discussed.

65 SMETANOVA, Dana
Palacky University, CZECH REPUBLIC

The Classification of Regular Second Order Lagrangians.

In this talk the regularity problems in field theory will be studied. The second order Lagrangians corresponding to Euler–Lagrange forms of orders 1, 2, 3 and 4 will be presented. Regularity conditions of the Lagrangians will be discussed.

66 SMIRNOV, Roman
Dalhousie University, CANADA

Invariants, Covariants, Joint Invariants and the Problem of Equivalence in the Invariant Theory of Killing Tensors

The theory of algebraic invariants of Killing tensors defined in pseudo-Riemannian manifolds of constant curvature is a natural fusion of the invariant theory and the geometric study of Killing tensors. Thus, much like in classical invariant theory where the vector spaces of homogeneous polynomials are investigated under the action of the general linear group, in this context the vector spaces of Killing tensors are studied under the action of the isometry group. The resulting invariants, covariants and joint invariants can be applied to various equivalence problems arising in the study of Killing tensors. Applications include the problem of orthogonal separation of variables in the Hamilton-Jacobi theory.

67 STUKOPIN, Vladimir
Don State Technical University, RUSSIA

Yangian Double of Strange Lie Superalgebra Q_n

The Yangian $Y(Q_n)$ of strange Lie superalgebra of Q_n type is described as a result of quantization of twisted current Lie superbialgebra of polynomial currents. Two systems of generators and defining relations for Yangian are introduced. Equivalence of this systems of generators and defining relations is proved. PBW theorem is formulated and proved. The double of Yangian and its central extension are described in terms of generators and defining relations. Formulas for universal R-matrix for double of Yangian and its central extension are computed. The some finite-dimensional representations of Yangians are described. Some aplications to integrable models are considered.

68 SWACZYNA, Martin

Ostrava University, CZECH REPUBLIC

The Nonholonomic Variational Principle

We investigate variational aspects of the theory of the first order mechanical systems subjected to general nonholonomic constraints. A nonholonomic constraint structure on J^1Y is given by submanifold Q fibered over Y and naturally endowed with the canonical distribution. A variational principle induced by the constraint structure is found, and the corresponding Euler-Lagrange equations are discussed.

69 TANOĞLU Gamze and PASHAEV Oktay

İzmir Institute of Technology, TURKEY

The Hirota Method for Nonlinear Evolution Equations with Three Distinct Roots

In this study the Hirota Method is applied to find the exact analytical solutions of the nonlinear evolution equations with the cubic nonlinearity. The first one has nonlinear reaction part in three dimensions. The second one is the non-linear wave equation in three dimension. The third one is scalar wave equation with convection term. For all cases, the reaction part has the form of the third order polynomial which has three distinct roots. We are able to exhibit analytic one soliton solutions and also give the relationships between these three simple roots and the wave speed of the soliton for the last two equations. We also exhibit the numerical solutions of the special cases for the third equation.

70 TÜTÜNCÜLER Hayriye, TÜRKDÖNMEZ Umut Bora and KOÇ Ramazan

Gaziantep University, TURKEY

Investigation of the Finite Group Invariance of $T \otimes (e \oplus t_2)$ Jahn Teller System

Jahn-Teller (JT) interaction matrices are constructed for $T_1 \otimes (e \oplus t_2)$ JT systems for Octahedral group by using the symmetry properties. In chemical applications of JT effect, the shape of adiabatic potential near instability point is of primary importance. Analysis of adiabatic potential energy surface (APES) is made by introducing a new approach for this group. Group symmetry is broken into its little groups due to JT interaction. This problem is devoted to the determination of extremum points on the JT surface by breaking symmetries of group into its maximal little groups.

71 VISINESCU, Anca and GRECU, Dan

National Institute for Physics and Nuclear Engineering, ROMANIA

Modulational Instability Of Some Nonlinear Continuum And Discrete Models

Modulational instability (also known as the Benjamin-Feir instability) of quasi - monochromatic waves propagating in dispersive and weakly nonlinear media is a general phenomenon encountered in hydrodynamics, plasma physics, condensed matter and is responsible for the generation of robust solitary waves (sometime solitons). The statistical approach is reviewed for several nonlinear systems: the nonlinear Schrödinger equation, the discrete self-trapping equation and the Manakov system. An integral stability equation is deduced from a linearized kinetic equation for the two-point correlation function. This is solved for several choices of the unperturbed initial spectral function.

72 VISINESCU, Mihai

National Institute for Physics and Nuclear Engineering, ROMANIA

Symmetries of the Dirac Operators on Curved Spaces

The Killing-Yano tensors play an essential role in the construction of new Dirac-type operators. The Dirac-type operators constructed with the aid

of covariantly constant Killing-Yano tensors are equivalent to the standard Dirac operator. The non-covariantly constant Killing-Yano tensors generate non-standard Dirac operators which are not equivalent to the standard Dirac operator and they are associated with the hidden symmetries of the space. The general results are applied to the case of the four-dimensional Euclidean Taub-Newman-Unti-Tamburino space.

73 WOOD, John C and LEMAIRE, L

University of Leeds, GREAT BRITAIN

Jacobi Fields along Harmonic Maps

A *harmonic map* is a mapping between Riemannian manifolds which extremizes energy; infinitesimal deformations of harmonic maps are called *Jacobi fields*. We describe the space of harmonic 2-spheres in CP^2 as a smooth submanifold of the space of all C^k maps ($k \geq 2$). There remains the question of whether all Jacobi fields along such harmonic maps are *integrable*, i.e. do they arise from variations through harmonic maps. We answer this affirmatively for harmonic 2-spheres in the complex projective plane but negatively for harmonic 2-spheres in the 4-sphere. The affirmative answer has a bearing on the behaviour of weakly harmonic E-minimizing maps from a 3-manifold to CP^2 near a singularity and on the structure of the singular set of such maps from any manifold to CP^2.

Çankaya University
Faculty of Arts and Sciences
Department of Mathematics and Computer Sciences

Department of Mathematics and Computer Sciences has 10 faculty members and 150 students. The department was founded on 1997. The curriculum includes programming languages in addition to core courses in pure and applied mathematics.

Research Interests are Applied Mathematics, Mathematical Physics, Differential Geometry, Integrable systems, Differential Equations.

Some selected papers are:

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- D.Baleanu, Y.Güler, *Hamilton-Jacobi and Symplectic Analysis of a Particle Constrained on a circle*, Czechoslovak Journal of Physics, Vol.53. (2003)
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