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Some algebraic models for differential geometry of second order [Abstract of thesis]

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RANDOM SETS AND THEIR INTERSECTIONS

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(14.9. 1987, supervisor J. Štěpán)

The principal aim of the theoretical part is the study of the relation between the concept of random sets and random automorphisms. The properties of random sets and the limiting behaviour of intersections of independent uniformly distributed random sets are analyzed in detail. The connection between random sets and measurable zero-one processes is then used to provide a probabilistic interpretation of fuzzy sets.

Using some analogy with the theory of probabilistic sampling from finite populations and random sets, the probability of inclusion of a point in a random set is defined. Introducing the concept of "inspection process", a relation is established between these results and the results concerning weak convergence of continuous stochastic processes.

A method of estimating integrals of an unknown function whose values are observed on a random set only is presented next. The estimate is proved to be unbiased and asymptotically normally distributed.

The results are then applied to develop a mathematical model of the propagation of corrosion. The study is supplemented with simulation experiments concerning the above and the distribution of measure of intersections of random sets.

CONSTRUCTION OF COUNTABLE TERNARY RINGS OF SUITABLE TYPES

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In the present work, the problem of existence of some types of nonplanar ternary rings using the method of Hughes (Proc. AMS 6(1955)) is solved. The work consists of six parts.

The first part is an introductory part and contains in a brief form a characterization of the work, the description of methods and some basic results. In the second part, necessary facts about ternary rings and, especially, the classification given by Havel and Studnička are presented.

In the third part, two types of special maps so called ρ-map and λ-map are studied in a detailed way.

In the next two parts, constructions of proper countable cartesian groups i.e. countable ternary rings of the type $IV_{(1)}$ and $IV_{(2)}$ are given. It is shown there that if we start with a partial algebra $(R,+,\cdot,0,1)$ where $(R,+)$ is a countable non necessary commutative group with the neutral element 0 and "$\cdot$" is a partial binary operation with the right neutral element $1 \neq 0$ and some additional conditions are fulfilled, then there exists a ternary ring $(R,T,0,1)$ of the type $IV_{(1)}$ or $IV_{(2)}$ which has the additive group isomorphic to $(R,+)$. In the last sixth part, the results of the fifth part are used for a construction of a countable nonplanar and nonlinear ternary ring, i.e. a countable ternary ring of type $IV_{(2)}$.

SOME ALGEBRAIC MODELS FOR DIFFERENTIAL GEOMETRY OF SECOND ORDER

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In the first part of the thesis (chap. 1-3), algebraic models of some geometric objects are studied. Categories of double vector spaces and double

vector bundles arising in differential geometry of the second order are int-
roduced axiomatically, and their basic properties are deduced. Further, an
algebraic definition of a double linear connection is formulated and an e-
quivalent characterization via flows and lifting of vector fields is given.
Finally, special connections on soldered double vector spaces are investi-
gated and a new way of finding all natural transformations of the second tan-
gent functor TT into itself and the functor TT* into itself is established.

SHORTENING OF THE UNIVERSAL CLASS IN THE ALTERNATIVE SET THEORY

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In the present thesis, problems of shortening the universal class in
the alternative set theory are investigated.
The result of the first part is the confirmation P. Vopěnka's hypothesis
on the possibility to interpret the alternative set theory in a theory, in
the axiomatic system of which there is no scheme of induction axioms and sa-
tisfying the condition that in those of its axioms which need the existence
of sets (except some variant of the axiom of prolongation), this existence
has an operational character.
New facts are presented in the second part, obtained by means of using
the procedures which led to the shortening of the uriversal class in the
first part of the work.
Here we have formulated and proved a theorem on existence of π-univer-
sa of specific properties and its consequence, namely a dualization of the
Levenheim-Skolem guaranteeing the existence of π-model for an arbitrary
first order theory having a countable model.(Under π-model we understand
a model with the following properties: First, the universum of the model is
the intersection of a countable class of sets, and secondly, any relation
and any function of this model appear to be an intersection of its universe
with some set.)
The use of the method of shortening of the universal class in the area
of the Δ_0-endomorphism (a generalization of an endomorphism) leads to a con-
struction of a model of Peano axiom system. The second part of the thesis ends
by its description.

THE SOLUTION OF SOME MAX-SEPARABLE OPTIMIZATION PROBLEMS

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Max- (min) separable optimization problems have found a considerable in-
terest in the literature, both theoretically and practically; such problems
have been studied extensively, e.g. by Butkovič and Hevery, Cunninghame-Green,
and Zimmermann.
The aim of this work is to derive some threshold type algorithms to sol-
ve some special cases of certain max-separable optimization problem of general
form

(1) $\quad f(X)= \max_{j \in n} f_j(x_j) \longrightarrow \min (\max); \max_{j \in m} r_{ij}(x_j):b_i, \; i \in s; \; k_j \leq x_j \leq K_j, \; j \in n$

where: stands for any of the relations $=, \leq, \geq$. f_j, r_{ij} are continuous func-
tions on $[k_j, K_j], k_j, K_j, b_i$ are given real numbers.
We state some geometrical properties of the set of all feasible solutions