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Two new proof techniques for investigating the computational power of two-way computing devices [Abstract of thesis]

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This result leads to the construction of the simultaneous confidence bands. The properties of the suggested method are illustrated in a simulation study.

The second part of the thesis deals with an extension to the twodimensional autoregressive model. The joint asymptotic normality of all the matrix parameter estimator, including the innovation variance matrix, is proved. The asymptotic behaviour of the spectral density estimator inverse is further studied. The simultaneous bands for the coherence function are set up using the expression

$$\mathcal{K}^2(\omega) = g_1' h(\omega) / g_2' h(\omega),$$

where $h(\omega) = (e^{-2pi\omega}, \ldots, e^{2pi\omega})'$. It has been found that the width of these confidence bands depends on the quantity

$$c_\alpha = \Phi^{-1}(\frac{1}{2}\alpha^{1/16p} + \frac{1}{2}).$$

TWO NEW PROOF TECHNIQUES FOR INVESTIGATING THE COMPUTATIONAL POWER OF TWO-WAY COMPUTING DEVICES

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Two new proof techniques for investigating the computational power of two-way computing devices are developed and presented in the thesis. One of them is a completely new technique and the second one is a generalization of the "cut and paste" technique originally used in [8].

Using the first technique we prove that two-way deterministic pushdown automata are more powerful than two-way deterministic counter automata. This method is also used by M.Chrobak in [6] for showing that two-way nondeterministic counter automata are more powerful than two-way deterministic counter automata. These two results settle two open problems posed in [4]. Our first technique is applied by Z.Galil in [3], too, for improving a result of [5].

We define a language L and prove, by virtue of the second proof technique, that any machine that recognizes L must satisfy $\mathrm{TIME}^2(n) \cdot \mathrm{Space}(n) \geq cn^3$. Our machine model allows k to read only input heads, where k is fixed, and the movement is like those of a multihead two-way finite automata. This result partially solves an open problem posed in [1,2]. Partially, since the heads are not allowed to jump. An immediate corollary of this result is that every multihead two-way finite automaton that recognizes L must have a time bound $T(n) \geq c(n^3/\log n)^{1/2}$. This result substantially improves a result of [7]. Our second proof technique is the first nondiagonalization method used for establishing the nontrivial time-space lower bound for Turing machines with two read heads on input tape [2].

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ALTERNATIVE MATHEMATICAL MODEL OF THE NATURAL LANGUAGE SEMANTICS USING FIRST-ORDER FUZZY LOGIC

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In the first part of the dissertation, a project of the alternative mathematical model of the natural language semantics is carried out. Its mathematical frame is fuzzy set theory and it stems from the functional generative description of the natural language which is elaborated by Prague linguistic group.

Lexical meaning of a word is modelled by a fuzzy set together with the property φ determining it. The model of semantics of nouns with their grammatemes and complementations and of adjectives with the grammatemes of degree and their connection with nouns is proposed. The meaning of a verb is a fuzzy set of fuzzy relations. It is also proposed how the grammatemes of the verb could be modelled. The model of word quantifiers and some adverbials is proposed and the model of the semantics of simple sentences is demonstrated.

In the second part, a syntax and semantics of the first-order fuzzy logic is elaborated. The syntax contains basic connectives of disjunction $\vee$, conjuction $\wedge$, bold conjuction $\&$, and implication $\Rightarrow$, additional connectives $o_j, j \in$ Jop, basic quantifiers $\forall, \exists$, and generalized quantifiers $Q_j, j \in J_q$. Some sound rules of inference in the form

$$r : \frac{\varphi_1, \ldots, \varphi_n}{r^{\mathrm{syn}}(\varphi_1, \ldots, \varphi_n)} \left(\frac{\alpha_1, \ldots, \alpha_n}{r^{\mathrm{sem}}(\alpha_1, \ldots, \alpha_n)} \right)$$

are introduced together with the concept of a proof of a formula φ_n

$$\omega = \varphi_0[\alpha_0; P_0], \ldots \varphi_n[\alpha_n; P_n]$$

and its value Val(ω) is defined. Some theorems on properties of the syntax and semantics are proved and the concept of a fuzzy theory $\mathcal{T}$ and its model $\mathcal{D}$ are introduced. The deduction theorem, closure theorem, theorem on constants and other ones are proved. The construction of the canonical model and a special