Usage of semantic technologies for representing non-precise or vague knowledge

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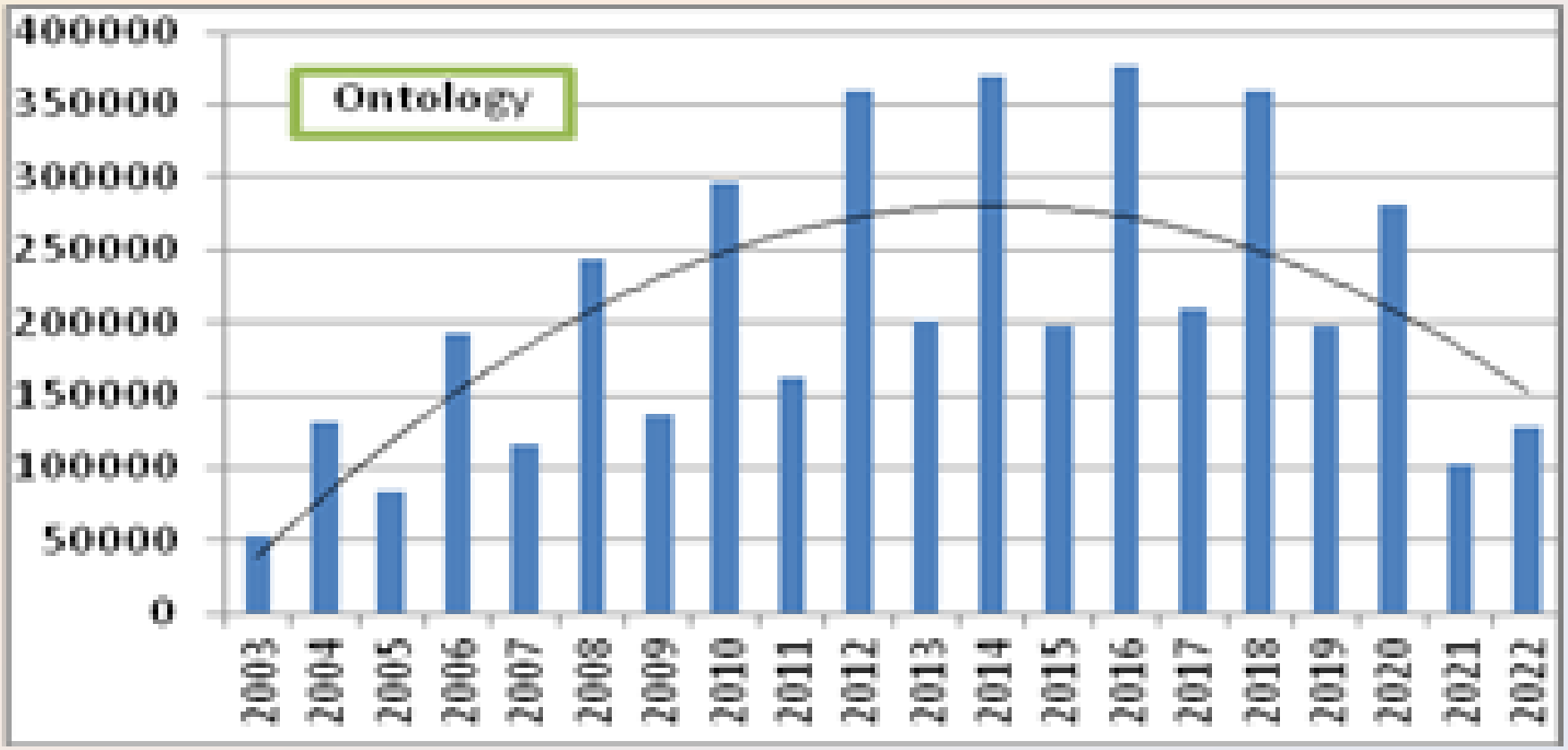
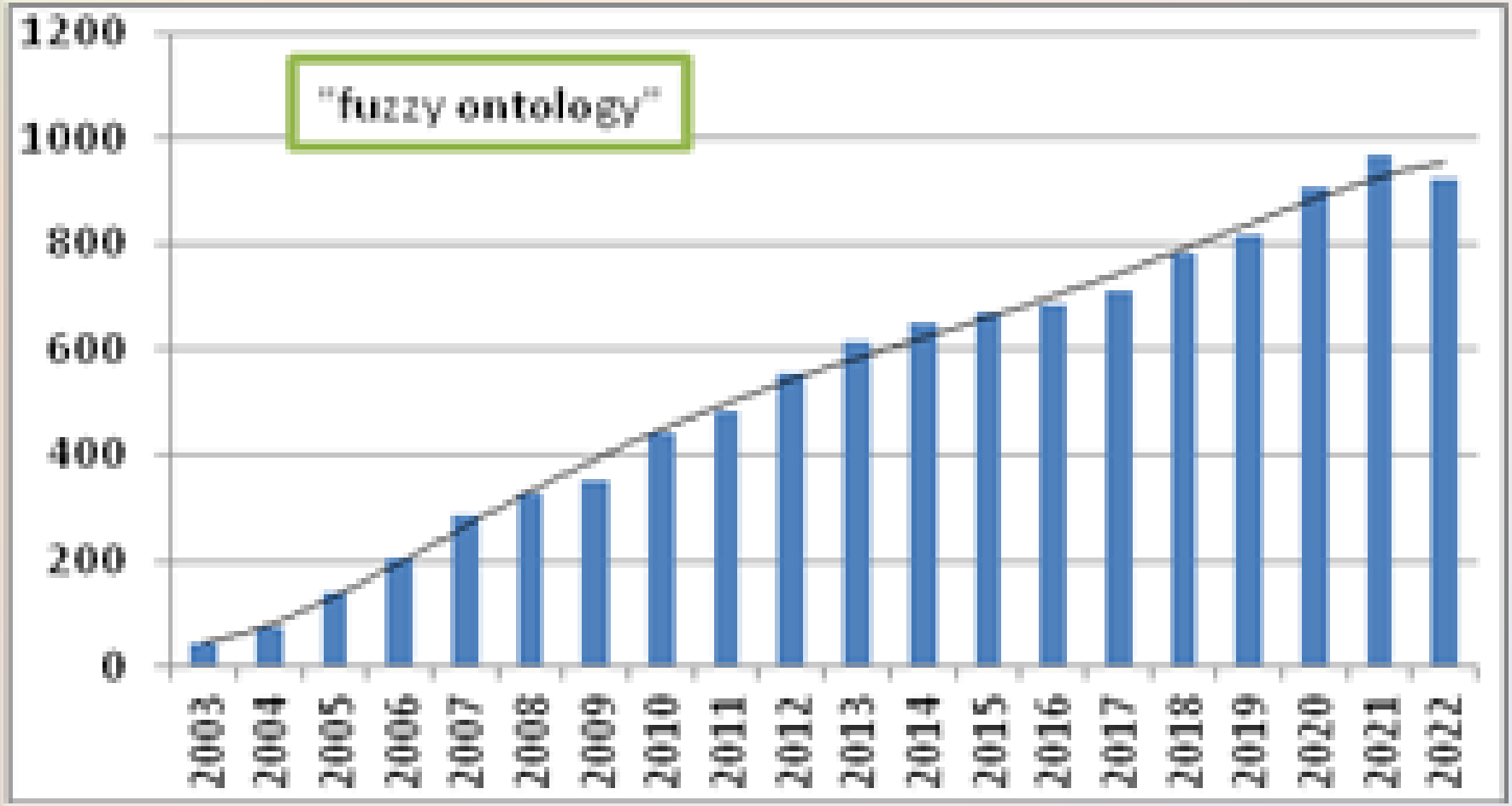
Our main research goals:

- To outline trends in the resent research on ontology development and usage
- To analyze possibilities of semantic modeling of imprecise and fuzzy knowledge
- To propose guidelines for selecting the best logic for fuzzy knowledge representation in selected application area.
- To propose a Methodology for selecting suitable fuzzy logic

Trends in the resent research on ontology development and usage :



Trends in the resent research on fuzzy ontology development and usage :



Approaches for usage of ontologies in knowledge uncertainty or vagueness context

- *Techniques for fuzzy knowledge representation*
- Types of reasoning mechanisms
- *Complexity and decidability of FDLs*
- Fuzzy ontology representation languages
- *Tools, developed for fuzzy reasoning over ontologies*

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Fuzzy knowledge representation - *FUZZY LOGICS*

Operator	Łukasiewicz logic	Gödel logic	Product logic	Zadeh logic
Conjunc-tion $\alpha \wedge \beta$ $\alpha \otimes \beta$	$\max(\alpha + \beta - 1, 0)$	$\min(\alpha, \beta)$	$a \cdot b$	$\min(\alpha, \beta)$
Disjunc-tion $\alpha \vee \beta$ $\alpha \oplus \beta$	$\min(\alpha + \beta, 1)$	$\max(\alpha, \beta)$	$a + b - a \cdot b$	$\max(\alpha, \beta)$
Negation $\neg \alpha \ominus \alpha$	$1 - \alpha$	1 if $\alpha = 0$ otherwise $1 - \alpha$	1 if $a = 0$ 0 otherwise	$1 - \alpha$
Implication $\alpha \rightarrow \beta$, $\alpha \Rightarrow \beta$	$\min(1\text{-}\alpha + \beta, 1)$	1 if $\alpha \leq \beta$ other-wise $\max(1-\alpha, \beta)$	$\min(1, b/a)$	$\max(1-\alpha, \beta)$

Types of reasoning mechanisms

1. Defuzification and reasoning by usage of crisp ontologies - ontologies are first reduced to crisp ontologies and then reasoning tasks are performed on crisp ontologies;
2. Usage of fuzzy tableaux reasoning procedures.
   - technoques aiming to adapt crisp DL reasoning algorithms to the specifics of fuzzy description logic.
   - Tableaux-based algorithms for vague ontologies

Fuzzy ontology representation languages and tools

1. Languages
   - OWL, using annotation properties;
   - Fuzzy OWL extensions - Fuzzy OWL

2. Tools - Fuzzy reasoners
   - FIRE,
   - FuzzyDL,
   - Delorean,
   - LiFR

Methodology for selecting suitable fuzzy logic

1. Selecting the model for representation of fuzzy sets (what type sets: type 2 or type 1 are more suitable);
2. Selecting logical theory, that is the most close to the domain uncertainty (see table 1);
3. Selecting inference mechanisms (defuzification, optimizations, or appropriate variant of tableaux reasoning algorithm);
4. Finding appropriate software tools (user interface, flexibility, easy usage for software development) for evaluation experiments or for practical usage;
5. Theoretical evaluation of effectiveness of corresponding fuzzy reasoning procedures (decidability, complexity);
6. Practical experiments on the effectiveness and correctness of results.

CONCLUSION

- Fuzzy ontologies are hot research topic;
- Fuzzy ontologies can handle effectively most of the types of vague knowledge, including linguistic vagueness, attached inherently to the most natural languages;
- Fuzzy reasoners are not standardized yet. They are experimental tools, having some drawbacks, including low efficiency, restricted logical capabilities, and difficult to use interfaces;
- Optimization procedures and using of logical models, having the lower possible logical complexity are very important for guarantying effective reasoning procedures;
- We propose a methodology for modelling imprecise information in many real domains and selecting suitable variant of fuzzy logic to represent knowledge in every practical domain.

Questions?

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