THE OBJECT ORIENTED BEHAVIOR MODELING AND SIMULATION OF HYDRAULIC CYLINDER

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The paper presents development a hydraulic cylinder model with the application of the software development methodology, known as object-oriented approach. For forming the conceptual model, energy mechanisms, from the bond graph methodology, are used. Transforming these concepts to classes we come up to the models directly executable on the computer.
The cylinder model is developed from complete modules through a few iterations. In the first step the cylinder is assumed as the static conversion mechanism. In the second step the model is expanded with the switch mechanism by which we represent piston displacement limits. In the third and forth iteration, the cylinder dynamics is assumed.

Keywords: *object oriented modeling, hydraulic cylinder behavior modeling, simulation.*

1. INTRODUCTION

We rarely have the possibility to regard some system in all its complexity. The ability to see what is essential and what is less essential presents the very basis for work with such systems. The model presents such an abstraction, that is, it presents a simple reality description so that this reality can be easily understood. What is going to be included in some model depends on the perspective of viewing the system. There is not a single model to be comprising all the system aspects, but each of them contributes to the system picture from some point of view.

In order to move easily through modeling space it is necessary to assume some methodology. According to [1] model development methodology is defined by three elements: work organization, modeling heuristics and modeling language.

The essential thing that defines one methodology is language for model description. What can be expressed in model is determined by the language in which it is stated. The language specified what terms can be incorporated in model (the vocabulary) and how these ones can be meaningfully combined (the grammar).

According to concepts, which define language vocabulary, nowadays we can distinguish two modeling methodologies [1-5]:

- Process oriented approach: system is structured by procedures (operations) that describe behavior from the highest to the lowest level.
- Object oriented (OO) approach: system is decomposed into structural elements that can interact among themselves.

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In both cases the base is functional analysis but the way of model organization varies. In the first case, the model is organized about the one "who works" whereas in the second case it is organized about the one "to work with". At process oriented approach the model is considered as the process, which contains functional blocks in the causal relationships. The system is viewed through the functions it performs. At the object oriented approach, the behavior model is described by the structure through which different functions can be performed. Constitutional structure elements are objects, which represent the instances of generalized abstractions from problems or solutions domain. With objects connection we come up to a typical graph, which represents the model architecture. The model architecture represents the base construction for different system functionality.

The most important thing in the appropriate model development is the essential knowledge of the system, which should be modeled. However, at the beginning of the model design, the modeler has the biggest design freedom, but the knowledge of the system is at minimum. At that phase, the model is the most useful but it is hard to come up to it. As the project advances, the system is better-known, but it's meaning diminishes as the choice of possible solutions is narrowed in line with designer's previous decisions.

In order to solve this problem, there are some requirements to be met in modeling methodology:

- Higher model flexibility,
- Iterative way of model development.

Easy modification and reuse of existing models in a different context is necessary as in accordance with