Achievements in Mechanical and Materials Engineering

COMMENT Worldwide Congress on Materials and Manufacturing Engineering and Technology
16th - 19th May 2005 Gliwice-Wisła, Poland

COMMITTEE OF MATERIALS SCIENCE OF THE POLISH ACADEMY OF SCIENCES, KATOWICE, POLAND
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13th INTERNATIONAL SCIENTIFIC CONFERENCE ON ACHIEVEMENTS IN MECHANICAL AND MATERIALS ENGINEERING

The use of networked IPC techniques in hybrid description of a simulation model*

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Abstract: Since now, many techniques of simulation model description have been evolved. Some of them are more suitable for complex models, the others are fast and easy. There is a problem to find the proper one for a given task. Sometimes it is better to use more than one technique to describe each part of model, then use specific application to simulate them. Because of information exchange between parts of a model, applications must have the capability to send and receive data from each other — this ability is named interprocess communication. In this paper an example of using networked IPC mechanism for hybrid description of a simulation model has been shown.

Keywords: Modelling, Simulation, Interprocess communication

1. INTRODUCTION

Evolution of numerical simulation techniques give to engineers new, ergonomic user interfaces used for assembly of parts of a model and simulation code generation. There are many types of computer applications on the market: one of them are huge systems with large capabilities, but also too complicated for easy and fast modelling, while others are simple for use, but can not manage complex models. It is known, that even very universal method may not be suitable for any model because of complexity — the description of a model can be overloaded with data required only by modelling application. According to the rule which says that the method should be good enough to describe a model on a given degree of complexity, engineer should find the most suitable one. On the other hand, in some applications a given system can be described only in a simplified way. It may be possible to use a different method to describe each part of a model (in different application) and provide communication between them — that means communication between applications. It looks very similar to distributed or parallel simulation process, but the main criterion here is simplicity of a model description. That means, the modelling environment consists of two or more simulators which are not homogenous — thus the method can be called a hybrid one.

* This work has been conducted as a part of research project 4 T07C 01827 supported by Committee of Scientific Research in years 2004-2006

2. SHORT DESCRIPTION OF THE IPC MECHANISMS

Almost every of a modern computer application has an ability to communicate with the others using operating system capability called Interprocess Communication. IPC enables the facility of sharing and exchange of data between the processes running on the same machine or among computers on the network. To do this task, an application should act as a client or as a server. IPC is also supported by MS Windows, which is still the most popular operating system for desktop computers. The DDE is the most popular one, because almost every application supports it. Moreover, data can be also exchanged over the network without modifying co-operating applications — only some system configuration tasks are needed. Even if an application can not support the network communication, there is a possibility to use an “interfacing application" for transmitting data. The network extension of the DDE, called NetDDE, requires some changes in the system configuration. First of all an application should be properly registered as NetDDE service, then the driver program should be loaded into memory. The manner of calling remote DDE service is based on the Universal Naming Convention standard. Client application exchanges data with remote server application trough the network DDE interface drivers running on each end of the network connection. The driver task is to translate the topic name sent by the client to DDE service name on a local computer. The general idea of networked DDE is shown in figure 1.

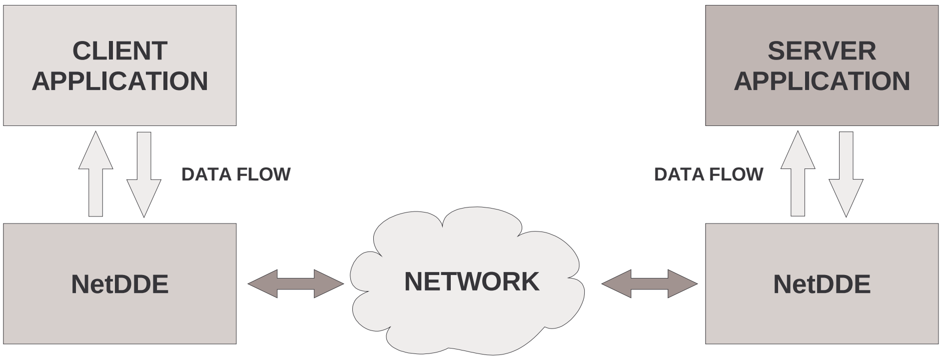

Figure 1. General idea of networked DDE

3. EXAMPLE OF HYBRID DESCRIPTION OF A MODEL WITH USE OF NETDDE MECHANISM

3.1. Description of the real system

As a subject of modelling a car has been selected. The goal of the virtual experiment has been to simulate accelerating of the car from 0 kmph to 100 kmph taking into consideration gears' changes and changeability of the engine torque. Main dimensions, weight, technical data describing gearbox with main transmission and engine characteristic have been brought from the service instruction [4]. The other data have been measured directly. In figure 2 the shape of the car with main dimensions is shown.

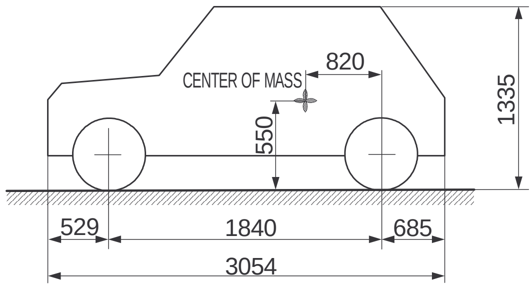

Figure 2. Main dimensions of the car (without load)

3.2. Assumptions for the virtual model

There are the main assumptions and simplifications for the virtual model:

- the car is driven on flat, homogenous ground*
- there is no air resistance against movement of the car*,
- there is no slip between the tyre and the ground*,
- the weight of the driver and passenger have not been taken into consideration (the mass of the model equals to overall mass)*,
- acceleration is done on fully opened throttle,
- there is no time delay between gear switching,
- elements of suspension are not modelled at all*,
- there is no interpolation of torque characteristic*.

Assumptions and simplifications marked with *) stand for the base model of the system and can be modified in future versions. Remaining ones are difficult for modelling or are not significant on the given degree of the model specification. For example throttle control and gear switching style are individual properties of every driver and there is no general rule how to do it.

3.3. Software used for modelling

Taking into consideration the given assumptions and the modelling goal there is the main problem relative to the model of the engine and the gearbox. This can be easily done with Working Model's GUI, but there is a lack of advanced functions that can be useful during engine and gearbox (gear switching) modelling. It is possible to manage data in other application [1,2,3], because Working Model has the capability to act as a DDE client [1]. Microsoft Excel seems to be suitable to do this task. Moreover, Excel can run on the other computer, so the simulation data can be gathered and presented in a more readable form that Working Model can do. Data flow between applications is shown in figure 3. Due to Working Model's inability to link directly through NetDDE, an "interfacing application" is needed.

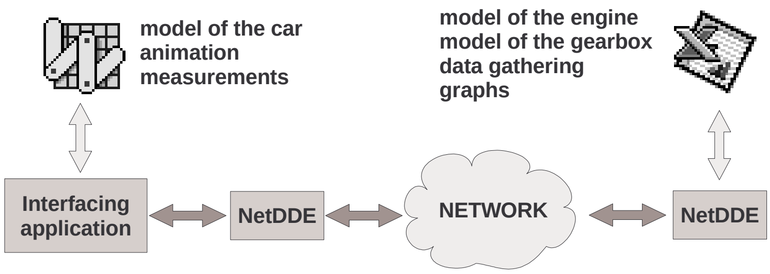

Figure 3. Data flow diagram between Working Model and Excel

3.4. The example of the virtual experiment

The virtual experiment presented in the paper has been based on default simulation parameters for both parts of model. There is no slip between the tyre and the road and the gears are changed when maximum engine torque is reached. In figure 10 the velocity, acceleration and distance in the function of time is shown.

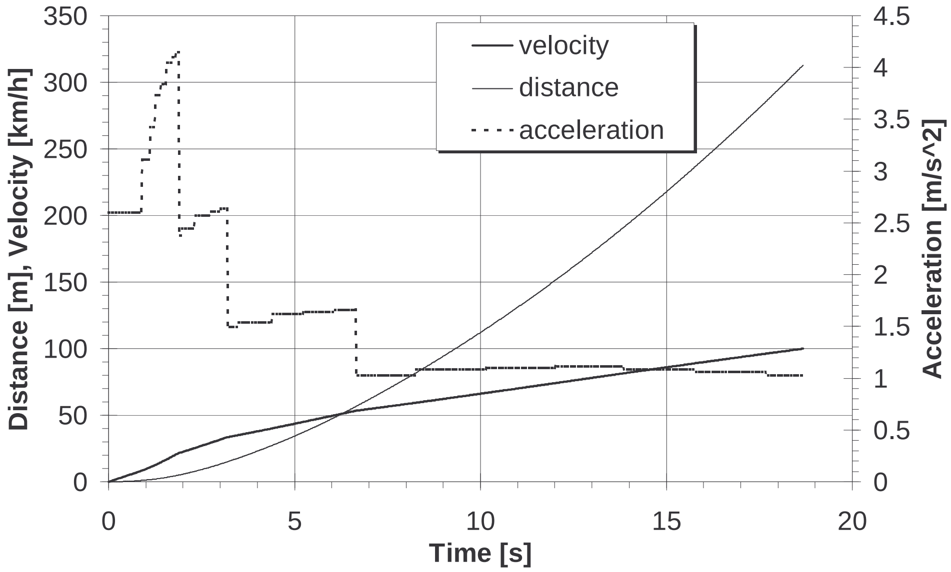

Figure 10. Graph of achievement during economic drive

4. CONCLUSIONS

The hybrid description of a model can be very useful during modelling complex systems. Moreover, the use of network IPC could made the modelling effort more efficient and comfortable. Another important advantage is that proper software may be installed on a remote computer and there is no need to get next licence for it. Especially the use of the networked DDE is possible with almost any application and does not need any special configuration or any adaptation of an application. Some disadvantages are not very troublesome in semi-professional or scientific application.

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