MANPY: AN OPEN SOURCE LIBRARY OF MANUFACTURING SIMULATION OBJECTS WRITTEN IN PYTHON

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ABSTRACT

Discrete Event Simulation (DES) is arguably one of the most popular operation research techniques. Even though Commercial-Off-The-Shelf (COTS) DES software has reached an impressive state of maturity, there are still problems that deter organizations from investing in such tools and adopting DES in their decision support processes. On the other hand, the nature of Open Source (OS) software development has properties that would help in overcoming problems such as high cost and lack of flexibility and reusability of DES projects. However, it seems that OS DES has so far achieved limited success, especially in fields like manufacturing, logistics or services. We present a new OS library of manufacturing DES objects called ManPy. We justify the need of such a project and describe the main driving ideas behind it.

1 INTRODUCTION

Commercial-Off-The-Shelf (COTS) simulation software has been around for decades and has significantly contributed to the diffusion of DES in the academic and industrial community, providing the user with tools for modelling, debugging and experimentation (Pidd and Cavalho 2006). On the other hand, such software introduces multi-dimensional cost that deters companies and especially Small and Medium Enterprises (SMEs) from adopting DES based solutions in their decision support (McLean and Leong 2001). Moreover, the lack of access to the source code often hinders important modelling aspects such as flexibility and reusability.

Given the above problems, an Open Source (OS) approach would seem as a competent comparative tool to COTS DES software providing lower cost solutions that can be tailored to the user's needs. Nonetheless, our review (Dagkakis, Heavey, and Papadopoulos 2013) revealed that, whilst there are some tools widely used in the domain of computer networks (e.g. OMNeT++ and NS-3), within Operations Research (OR) there is currently no dominant OS DES tool. One reason our review identified is that most of these projects are primarily targeted towards computer experts, losing the possibility to be adopted by users with wide modelling, but limited coding, experience. Our scientific question is: is it possible to create an OS DES library for use in OR that can be utilized by the range of users in this domain?

2 MANPY

ManPy stands for "Manufacturing in Python". It is developed in the Python programming language and utilizes the SimPy (http://simpy.readthedocs.org/en/latest/) framework in order to implement the process interaction simulation world view. The scope of ManPy is to offer a structured layer of well-defined manufacturing objects that is built above SimPy. These objects can be connected as black boxes in order to form a model, in a similar fashion with most COTS software. Furthermore, an expert user can manipulate the Application Programming Interface (API) that ManPy offers for simulation, to customize the objects or create completely new ones and incorporate them into the library.

In order to achieve this extensibility ManPy classes follow a hierarchical architecture as shown in Figure 1. This is an attempt to abstract the simulation model into a set of CoreObjects that exchange Entities. Both these types may need ObjectResources for certain operations, while ObjectInterruptions may affect the availability of an object at a given simulation time. Auxiliary classes and methods help in interfacing with other software and creating and executing simulation models. Following a clean design and actively updated documentation, ManPy aspires to be usable, at different levels, by both modelling and software experts. The merits of Python, which is a language that is becoming very popular in the scientific community (Grandell and Peltomäki 2006) is considered as a major asset in this effort.
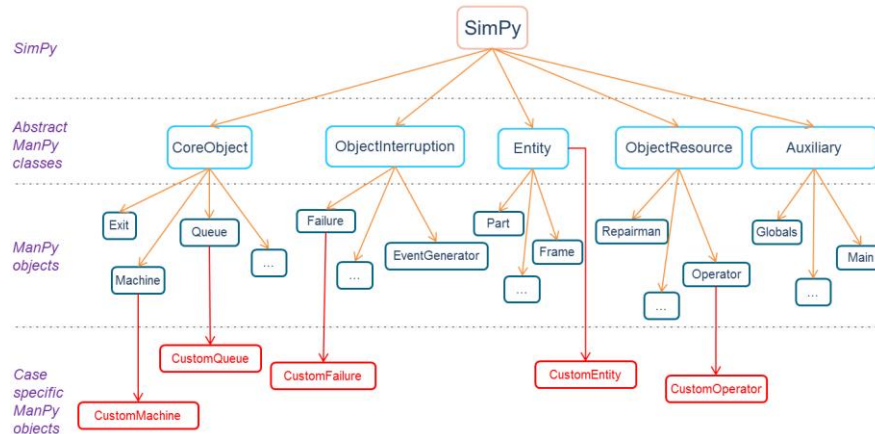

Figure 1: ManPy architecture

ManPy is being currently validated through four industrial pilot cases, which also dictate requirements for the technical characteristics of the library. The project has actively progressed and released as OS in https://github.com/nexedi/dream under the Lesser General Public License (LGPL). For more information on the library the reader is referred to Dagkakis et al. (2013), while a more technical and actively updated description exists in ManPy documentation in the OS repository of the project.

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