



An Object-oriented Solution to ARGESIM Comparison “C6 - Emergency Department” with MATLAB-DEVS2

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Simulator: MatlabDEVS2 is a simulation runtime system designed for research on the classical DEVS theory. It offers support for developing models following the formalism of this theory. Since the classical DEVS theory introduced by Zeigler works with a very high level of abstraction, a simulation runtime system implementing this formalistic description may just be a system for explaining the theory. Therefore, it is suitable for research and education tasks but not for commercial issues.

MatlabDEVS2 is a further advancement of MatlabDEVS which was developed by T. Pawletta in 1998. It is an open system embedded into the Matlab environment implemented taking benefit of Matlab's features for object-oriented programming. It uses the same base classes for both, model building and simulation. The entire source code may be downloaded at www.mb.hs-wismar.de/MatlabDEVS2.

Model: The DEVS approach uses a hierarchical structure for modelling. *Atomic models* involved are:

Name	
patientgen	generates patients
transducer	collects patient, computes statistics
queue	queues in front of the casualty wards and X-ray rooms
singlequeue	queues in front of registration and plaster rooms
server	X-ray-and plaster rooms, registration counter, doctors
controller	controls patient's flow assigns next treatment point

Special attention should be paid to the atomic model 'controller'. While queue, singlequeue and server represent parts of the real world system, the controller is added to minimize the information flow between the different facilities at the emergency department a patient has to pass by during follow-up treatment.

The *coupled models* are:

Name	Represents	Components
EmergencyDepartment	whole system	EF ED
EF	experimental frame	patientgen transducer
ED	emergency department	2 x UNIT1 (REG+PLA) 3 x UNIT2 (2 x CW, X-RAY) controller
UNIT2	X-ray rooms + queue doctors + queue	queue 2 x server
UNIT1	plastering room + queue registration unit	singlequeue server

Besides the atomic and coupled model classes representing the parts of an emergency department there is one more class definition for usage at simulation. Patients which are served at emergency department are also defined using Matlab's object-oriented features.

Task a: Overall Treatment Time. The task was performed for 20 simulation runs each time sending 250 patients of different type through the hospital.

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Simulation Results for Emergency Department after 20 Simulation Runs:
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Total number of served patients = 250
Mean treatment time           = 172.9481 min
Standard deviation             = 81.6598 min
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Patients of type1 (CW-->X-Ray-->CW) = 86.4737
Mean treatment time           = 234.4915 min
Standard deviation             = 65.8564 min

Patients of type2 (CW-->Plaster) = 49.4737
Mean treatment time           = 137.9089 min
Standard deviation             = 62.5007 min

Patients of type3 (CW-->X-Ray-->Plaster-->X-Ray-->CW) = 13.8421
Mean treatment time           = 253.7842 min
Standard deviation             = 53.9893 min

Patients of type4 (CW) = 100.2105
Mean treatment time           = 125.7266 min
Standard deviation             = 59.5823 min

Duration = 375.1949 min
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Task b: Doctor Exchange Strategy. This strategy offers no advantages nor for patients neither for leaders of the emergency department. Mean treatment time as well as overall business hours increased.

Task c: Priority Ranking. Patients which enter a treatment point for the second time rank higher in priority than others. To perform this task queues and singlequeues needed to be enhanced with the facility to insert patients into the queue at a defined position. Standard deviation decreases and the emergency department could close about 40 minutes earlier.

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Simulation Results for Emergency Department after 20 Simulation Runs:
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Total number of served patients = 250
Mean treatment time           = 161.0801 min
Standard deviation             = 74.8611 min
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Patients of type1 (CW-->X-Ray-->CW) = 86.8421
Mean treatment time           = 161.9408 min
Standard deviation             = 75.3273 min

Patients of type2 (CW-->Plaster) = 49.7895
Mean treatment time           = 163.3995 min
Standard deviation             = 74.6603 min

Patients of type3 (CW-->X-Ray-->Plaster-->X-Ray-->CW) = 11.9474
Mean treatment time           = 175.4764 min
Standard deviation             = 72.5793 min

Patients of type4 (CW) = 101.4211
Mean treatment time           = 157.3547 min
Standard deviation             = 74.4887 min

Duration = 377.4275 min
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C6 Classification: Object-oriented DEVS Approach

Simulator: MatlabDEVS2, Rec. Release 2003

