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Design of Machinery Fault Diagnosis Mobile Laboratory

Author: Sevan Der Sarkissian Hajiabadi

Akian College of Science and Engineering & NI Armenia

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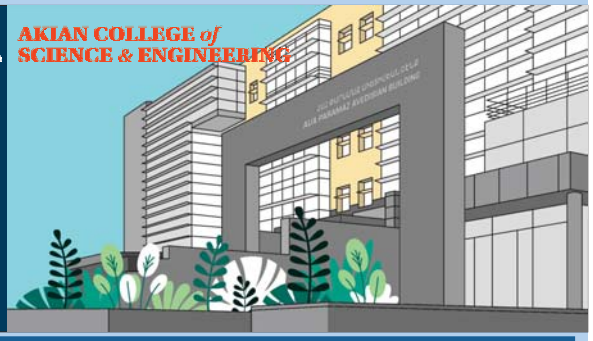

Introduction

The growing demand for on-site diagnostics and repair of machines and mechanisms in almost all fields of industry stimulates the necessity to find new engineering approaches and solutions. The rapid development of real-time data acquisition, measuring and analyzing systems makes mobile fault diagnosis laboratories one of these solutions.

The project is a virtual realization of the idea of creating a mobile laboratory for machinery fault diagnosis with the help of Computer-Aided Design tools. According to the idea proposed by our NI Armenia colleagues, the application field of the laboratory should be on-site control and troubleshooting of different technical systems in fields, production workshops, and other hard-to-reach regions. 2D layouting, 3D modeling, mechanism design and animation methods applied in the project show how efficiently the CAD tools can be used for the mentioned task. The 3D model of the laboratory installed in an off-road vehicle provides the opportunity to observe the product virtually, experiment different scenarios, find better solutions, and see the obstacles before the physical implementation of the idea.

Design Process

Two “off-the-shelf” components of the mobile laboratory were the measurement and automation system and the vehicle. The former was proposed by the NI Armenia based on the specified needs for data acquisition and diagnostics (Fig. 1). The latter (Fig. 2) was chosen by the author based on the space and cost considerations.

Fig. 1 PXI-1000B

Fig. 2 UAZ Hunter SUV

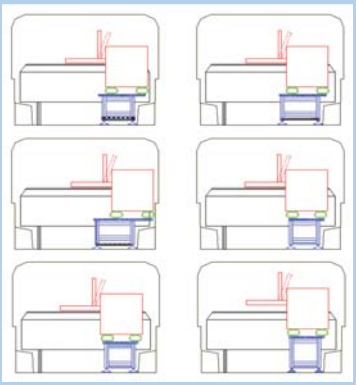

Fig. 3 Layouts

Fig. 4 Manikin module

Several alternative layouts (Fig. 3) helped to define the optimal placement and sizes of the table of the PXI system. Pro/ENGINEER’s Manikin module was used for the ergonomic design of the lab (Fig. 4)

Table Design and Final Model

One of the important tasks of the project was the design of the table. On one hand it should have provided safety for the sensitive PXI system during off-road transport and on the other - firm fixation during the work when the vehicle is at rest. The appropriate damping and fixing components were included in the design. The technical drawing of the exploded view of the table and its bill of materials are shown in Fig. 5. The table contains complete information about the quantity of the components, their cost and materials. The final assembly of the mobile laboratory with the operator is depicted in Fig. 6.

Item	Component	QTY.	Cost[$]/Unit	Total Cost[$]	Material
1	LEVELING_BASE_MOUNTING	4	15.000	60.000	Steel, Zinc plated
2	M6-1_NUT	10	1.000	10.000	Alloy Steel, Hardened
3	M6_SLIDE_NUT_PP250	4	0.700	2.800	Alloy Steel, Hardened
4	M6_SPRING_WASHER	28	0.090	2.520	High Alloy Steel Gr. 10.9
5	M6X16_BOLT	4	0.170	0.680	Alloy Steel Gr. 12.9
6	M6X20_BOLT	4	0.180	0.720	Alloy Steel Gr. 12.9
7	M6X30_BOLT	20	0.190	3.800	Alloy Steel Gr. 12.9
8	PP250_SHELF	1	15.750	15.750	Aluminum, anodized
9	PP50_FRONT_BACK	3	2.750	8.250	Aluminum, anodized
10	PP50_SIDE_LOWER	2	1.250	2.500	Aluminum, anodized
11	PP50_SIDE_UPPER	2	1.250	2.500	Aluminum, anodized
12	P560X40_BACK_LEFT	1	2.050	2.050	Aluminum, anodized
13	P560X40_BACK_RIGHT	1	2.050	2.050	Aluminum, anodized
14	P560X40_FRONT_LEFT	1	2.050	2.050	Aluminum, anodized
15	P560X40_FRONT_RIGHT	1	2.050	2.050	Aluminum, anodized
16	P750_375	1	24.500	24.500	Aluminum, anodized
	Grand Total	87		142.220	

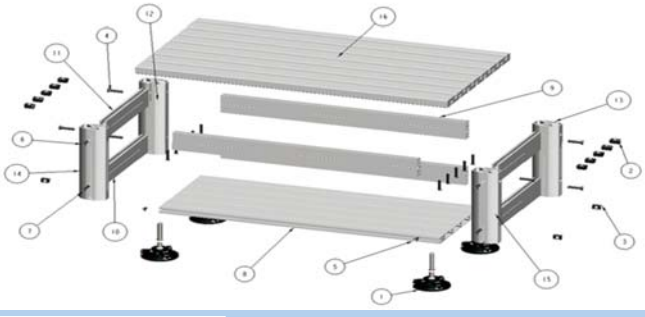

Fig. 5 Drawing of the table

Fig. 6 The mobile laboratory