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Design and Simulation of Rotary System Training Stand

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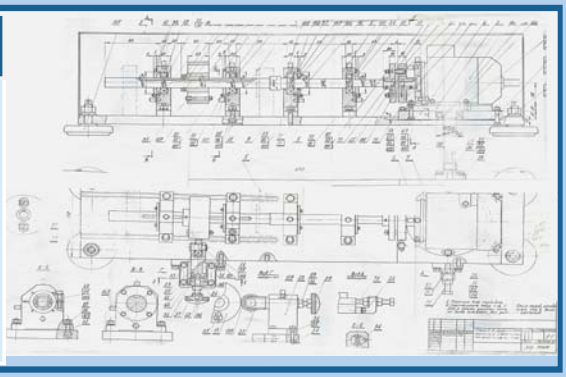
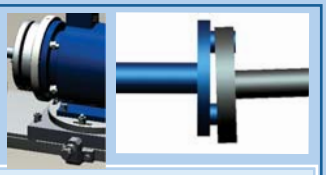
Introduction

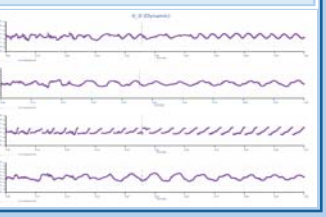
The 3D model of the training stand is created based on the design specifications from NI Armenia. The stand is designed to investigate the behavior of the rotary system subject to varying disturbance factors, such as axial and angular misalignment of the rotary shaft with the axle of the motor, radial load, misalignment of the coupling, etc. The purpose of this project is to develop a three dimensional simulation model of the stand. It can provide engineers with an environment to observe the behavior of the system. To experiment with a simulation model, users can vary levels of factors possibly affecting the performance of the system, run analyses under different scenarios, and retrieve measures of their specific interest. The 3D model of the stand is created for assembly control and visual representation. The simplified model of the stand, including all necessary conditions and constraints, is developed in the Mechanism Design module of Pro/Engineer, and the results of the simulation were analyzed using Design of Experiments methods. At right is the manual drawing of the stand done by NI Armenia engineer Vladimir Mkrtchyan.

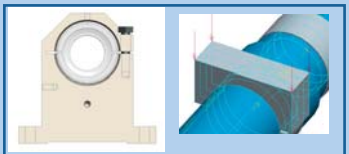


Simulation of Mechanical Disturbances and Plotting the Forces in Bearings for Different Disturbances

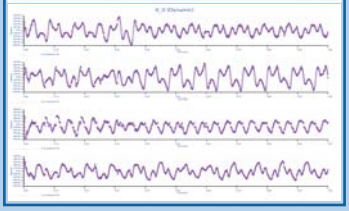


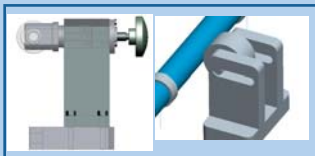
Linear and angular misalignment of the rotary shaft and the axle of the motor, which on the physical model is achieved by adjusting the placement of the motor, on the virtual simplified model is simulated by assigning translational and angular deflection parameters and analyzing the forces by changing those parameters.



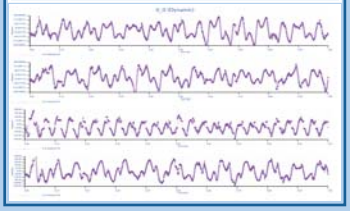


Misalignment of the axes of the bearing support and the bearing, which in the physical model is achieved by tightening and untightening the screw on the support, in the virtual simplified model is simulated by adding forces on the support and measuring contact forces between the support and the bearing.

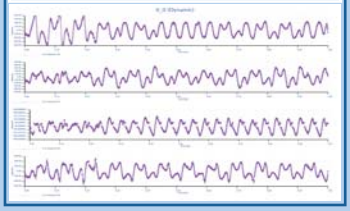




In the physical model, the disturbance of the **external radial force** is assessed by the forced contact between the roller and the shaft of the rotary system. In the virtual model, we applied a *force motor* with a force as a variable parameter. By changing this parameter, we can measure the forces occurring in bearings.



The **imbalance** on the real stand is simulated by means of a mass (the red bolt on the pic) that can change its placement radius, and hence - the imbalance amount, by moving in the radial slot. To simulate this disturbance, a cylindrical body was created within the rotary shaft, the placement of which can also be easily changed during simulation.



Results

The results of the project were used by NI Armenia as a visual aid to represent the concept of the training stand during the discussions and presentations. The project demonstrated how advanced CAE tools can be used to transform the concept of the educational training stand into a 3D model and simulate experiments at the early stages of the product development. We used Design and Analysis of Experiments to analyze the performance of the rotary system subject to different design configurations. SPSS statistical software was utilized to analyze the data acquired by means of mechanism simulation.

The results of the project were represented during the DigiTec-2008 Information & Communication Technology and High Tech annual exhibition held in Yerevan.