RESUME DE LA THESE

In the thesis, the method based on optimal motion planning of the common center of mass is developed and extended on planar and spatial parallel manipulators.

Firstly, two types of planar parallel manipulators are considered: 5R and 3RRR. In these manipulators, by generating the input parameters of the actuated joints that ensure the optimal motion of the common mass center, the partial reduction of the shaking forces transmitted to the frame is achieved. It is imperative to note that the proposed balancing is carried out without adding counterweights. The obtained results showed that the generation of the trajectory of the common mass center of the manipulator by « bang-bang » profile provides a significant reduction in shaking forces. Although the goal of these studies was not the further decrease of the shaking moments but it is observed that a considerable reduction in the shaking moment is also obtained. The absence of additional masses and the optimal generation of the center of mass trajectory can explain this.

Some observations showed that the control of manipulators based on the kinematic parameters of a virtual point as a center of masses leads to additional inconvenience. For example, measurements and refinements of the displacements of the total mass center of moving links becomes pretty complex. To eliminate this drawback, the approach based on the combination of mass redistribution and motion planning has been also considered. The simulation results showed that in this case a reduction of 60% of the shaking force can be achieved.

The problem of shaking force balancing of spatial parallel manipulators was then discussed. Two types of spatial parallel manipulators have been considered: the Delta robot and the Orthoglide. It is known that due to the complexity of the spatial parallel mechanisms, the complete shaking force balancing is difficult to obtain. Therefore, the suggested balancing approach based on optimal acceleration control of the common mass center, becomes more benefits. By defining the trajectory of the common center of mass as a straight line, and parameterizing its motion with « bang-bang » profile, the maximal value of the shaking force has been reduced.

In the current industry, the errors of fabrications and assembly cannot be avoided. In the last chapter, the error-sensitivity analysis of the developed balancing strategy has been proposed in order to evaluate the parameters, which affect more errors on the shaking force and the position accuracy.

Finally, it should be noted that despite the fact that the developed balancing technique ensures only partial solution of the shaking force balancing, it appears that the suggested solution can be attractive for industrial robot applications because it can easily be implemented in practice.