ANNALS of the ORADEA UNIVERSITY.

Fascicle of Management and Technological Engineering, Volume VI (XVI), 2007

SPECIFYC METHODS FOR SYNCHRONIZE THE PARALLEL FEED MECHANISMS

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Keywords: Parallel mechanisms, gantry, feeds.

Abstract.

Preoccupation off researcher on world wide consist in optimization of the feed mechanisms of fated advances of the machines tools, robots, monorail and manipulators which are incorporated in the flexible systems of manufacturing.

Due to the economic and flexibility factors, the performances of equipments are all exacting maul, respectively the accuracy, the speed the as well as the reliability.

1. INTRODUCERE.

The utilization of the parallel feed mechanisms brings multiple advantages, such as: big accuracy of position, the proportion weight between the body transported and the feed mechanism in report with the classical mechanisms, static rigidity and dynamics due to the combination formats of two servomotors on a feed axis, produce a major couple than one met to the conventional mechanisms. [2]

For the development of the equipments in the future, the linear parallel feed mechanisms and rotary feed mechanisms shall deal a primordial role. This position is given from the viewpoint of the elevated performances toward the conventional systems with one feed mechanisms quotient and the report of the price.[5]

The implementation prices on a system of a parallel axes concept is much more than choose of a classic system with an only one feed mechanism at same performances.

Due to the elevated performances ale different equipments, to the current hour, which compose the lines of production of the flexible manufactured systems, the more precise because of the very reduced time necessary to realization of a product, resource manipulators systems are intense operation.

In the gantry axes case it is noun many diferents types of actuations of the two paralel feed mechanisms, depending on the requirements of the system.

In the case of the driven axes with two servomotors:

- Dynamic synchronization.
- Differential synchronization.

2. DYNAMIC SYNCHRONIZATION

Dynamic synchronization is typical on a parallel feed mechanism driven with two servomotors on mechanisms, more précis gantry mill. The synchronization is obtained with an equipment specialized, that can in real-time supervise and operates on the both synchronic mechanisms depending on the information tacked over from the encoders. [6]

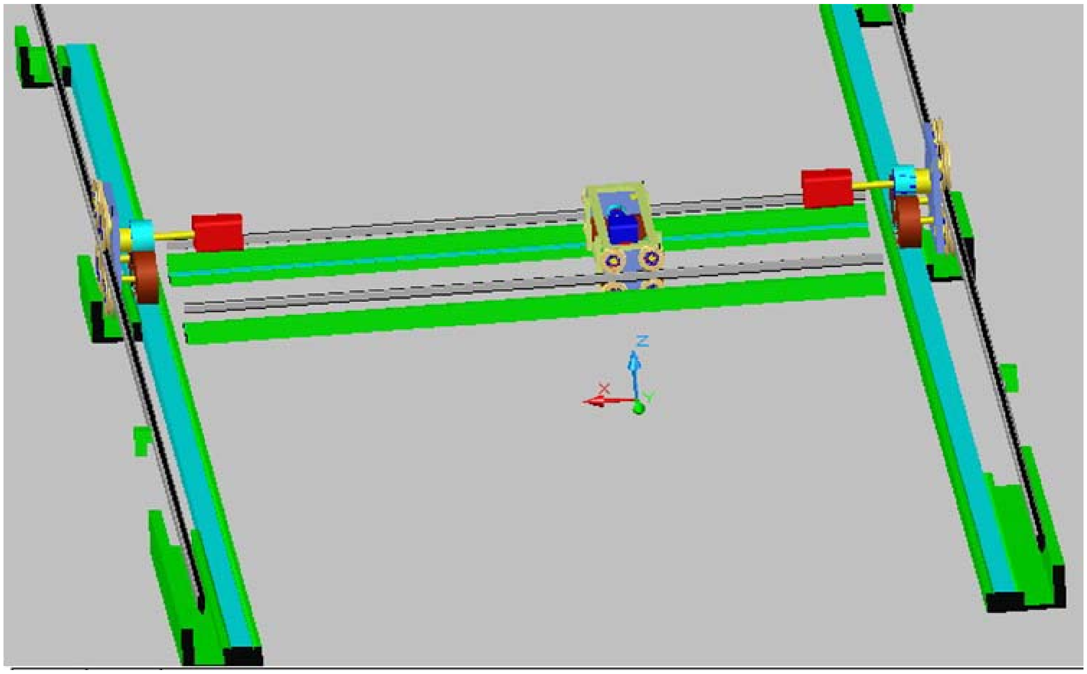

Figure 1. Dynamic synchronization.[6]

In the parallel feed mechanism case, in figure 1, the axis Master and the axis Slave are synchronically driven, with same revolutions n = n', resulting an equal advance on each axis, s = s'.

The discrepancy between the feed system with an alone feed mechanism and a parallel feed acted of two servomotors synchronization with a special equipment consist in the fact as the real-time in the operation servomotors is supervised.[5]

The principle of management of this type of mechanism is that one of the axes becomes the Master axis and second become the Slave axis.

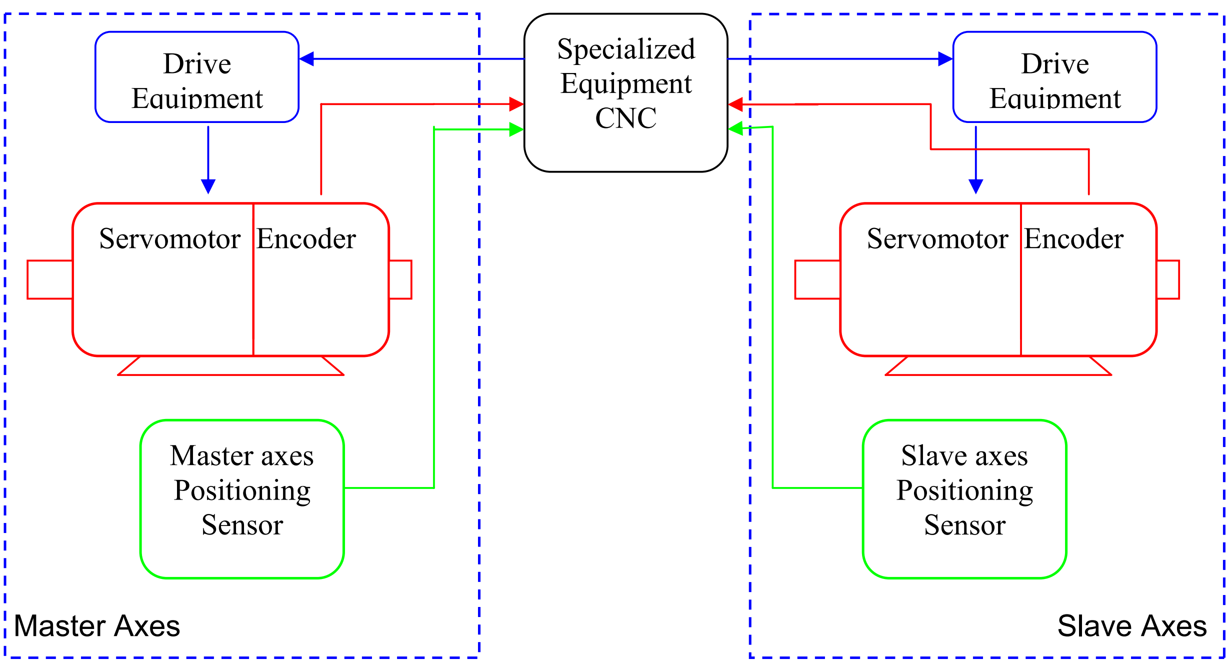

Figure 2. The dynamic synchronization diagram.

The Master axis is the axis mark as the standard to by controlled and a typical CNC axis. The axis Slave is drived the synchronic depending on the state leading axis.

The compensation due the variations events of elastic deformations and different type of errors of the both mechanisms, consist in acceleration or braking of one mechanism, mechanism named conventional the Slave axis, so that this, real-time, to coincide as position with the axis master.

3. THE DIFFERENTIAL SYNCHRONIZES.

The differential synchronization is encountered at the parallel feed mechanisms driven by a differential adder, specific to gantry drill axis. [3]

This type of synchronization is characterized through the fact that one of the servomotors drills the differential gear, and the second servomotor has a role of compensative element. In the case the equipment detects certain differences regarding the position of the mobile organ, the servomotor having a compensative role, will react on one of the branch of the differential sectors, in order to position the parallel feed mechanisms.

The compensation can be achieved as in real-time, quotient the moment in which the mobile element arrives at the end of the race.

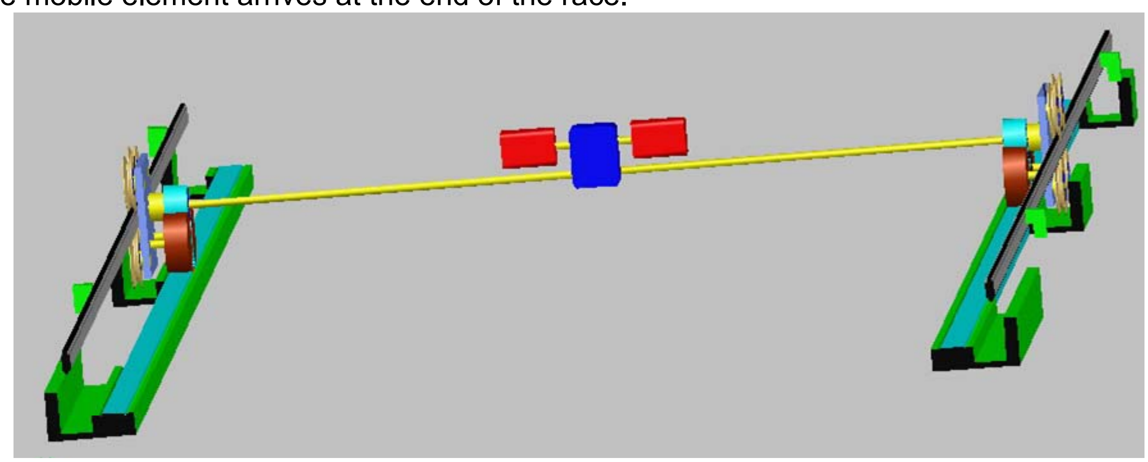

Figure 3. Differential synchronization.[5]

In case of differential synchronization is often encountered the use of the determination of deformations with finite element. [3]

Finite element model is used for the calculation of the structural deformations, and also for structural components of parallel feed mechanism, support tension, compression, torsion and flexion. [7]

Figure 4 presents the model of the manipulator used to calculate the structural deformations, with all the loads applied at the contact surfaces, the acceleration gravity vector, and the restrictions to the six degrees of freedom at the manipulator base (nodes 1, 10, 11 and 20). Figure 5 represents the deformed condition of the manipulator calculated. [7]

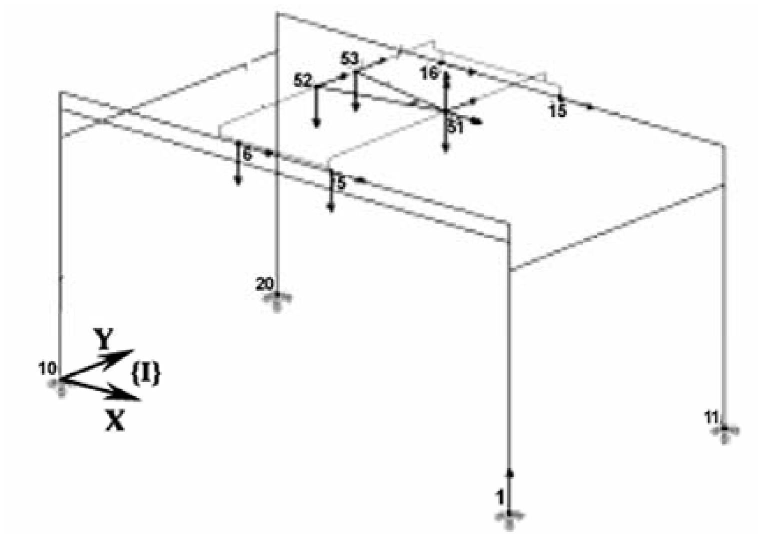

Figure 4. Finite Element Model used for the calculation of the structural deformations.[7]

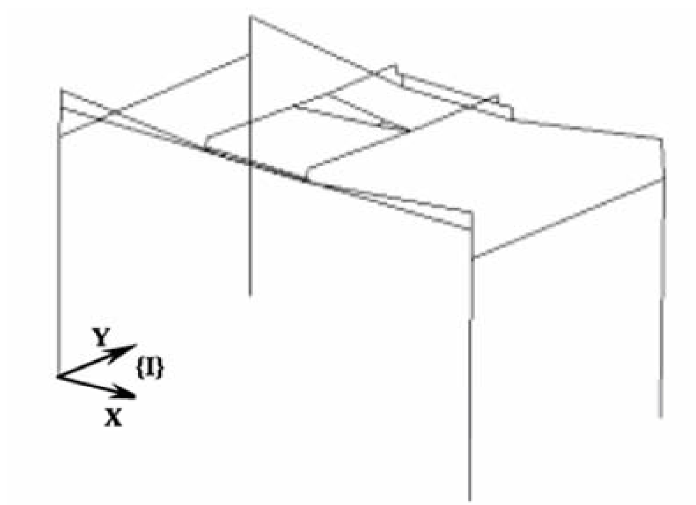

Figure 5. Deformed condition of parallel feed mechanism for finite element.[7]

The values of the positioning deviations of the end-effector extremity are essentially dependent on the elastic deformations caused in the manipulator during the realization of a given task. In the FEM modeling the module Z, figure 6, was defined by the elements connected by the nodes 51, 52 and 53; and nodes 62 and 63, which are defined to locate point 60. This node (Node 60) is the point where the arm containing the end-effector is assumed to orthogonally intercept the plane, see figure 7. The planes and D represent, respectively, the undeformed and deformed conditions of the manipulator. In order to obtain the end-effector extremity coordinates is used the D-H parameter d4 (defined in the kinematics analysis) which represents the arm extended length. The End-effector position deviation D is given by equation (1), where x, y and z are the desired End-effector extremity coordinates in the reference systems. [7]

$$D = \begin{Bmatrix} x - \dfrac{x_{62D} + x_{63D}}{2} + d_4 \cdot n_{Dx} \\ y - \dfrac{y_{62D} + y_{63D}}{2} + d_4 \cdot n_{Dy} \\ z - \dfrac{z_{62D} + z_{63D}}{2} + d_4 \cdot n_{Dz} \end{Bmatrix} \quad (1)$$

where:[7]
xijD = position of Node ijD in the X direction, (mm); Figure. (6).
yijD = position of Node ijD in the Y direction, (mm);
zijD = position of Node ijD in the Z direction, (mm);
nDk = component k of the plane □D normal vector.

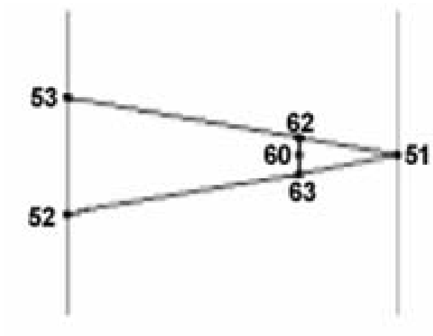

Figure 6. Plane view of the deformed parallel feed mechanism.[7]

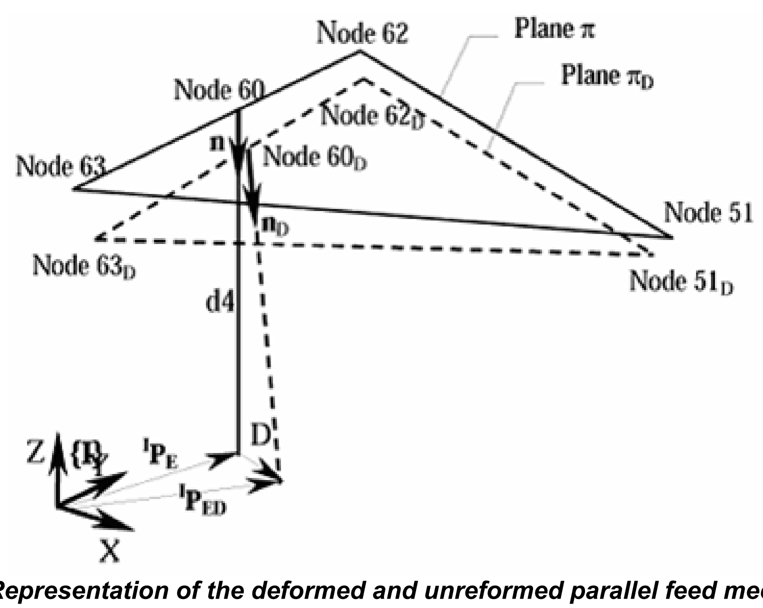

Figure 7. Representation of the deformed and unreformed parallel feed mechanism.[7]

The parallel feed mechanism performance is related to the specification of its tasks. A task can be interpreted as a temporal relation between kinematics and inertial parameters. After the definition of the manipulator movement, the kinematics parameters are obtained for the specified path and the values of the mechanical loads applied at the elements are calculated. Then these data can by used in the FEM modeling to calculate the deformation of the manipulator, which results are used to determine the end-effector extremity position deviation.[7]

4. CONCLUSIONS

The only constructive solution to this hour for the manipulators whit big velocity and long tacks is the adoption of the parallel feed mechanisms.

A monorail manipulator with parallel feed mechanisms can serve easily else many the equipments, just a whole line of in a manufacturing relative reduced time.

The choosy for this solution confer a very big level of flexibility at necessary space for the access to the equipments is reduced.

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