ANALITYCAL POSITION ANALYSIS FOR RSRC MECHANISM

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Abstract: The aim of the paper is obtaining the analytical relations for position analysis of spatial RSRC mechanism. The method is based on the homogenous operators method proposed by Hartenberg and Denavit, considering the specifications due to McCarthy. Subsequent to the obtained analytical relations, the graphs of the position parameters dependences from the kinematical joints of the mechanism are presented for an explicit case.

The position kinematics parameters from mechanism's joints are found by means of closure matrix equation of the mechanism, as it follows:

- ζ, η, ξ for spherical pair;
- θ_3 for revolute pair;
- s, θ_4 for cylindrical pair,

as functions of constructive parameters L, d_0, r, s_0, α and of revolute angle θ_1 of the crank. The following relations were obtained:

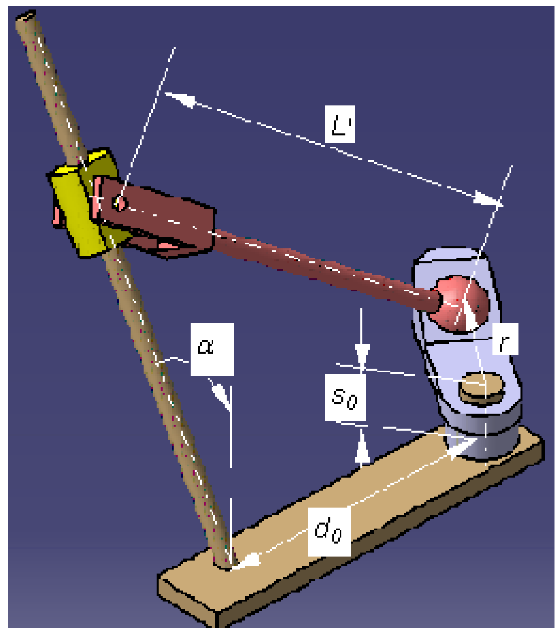

Fig. 1. RSCR Mechanism

$$s = -(s_0 \cos\alpha + r \sin\alpha \sin\theta_1) \pm \sqrt{(s_0 \cos\alpha + r \sin\alpha \sin\theta_1)^2 - 2rd_0 \cos\theta_1 - s_0^2 - d_0^2 - r^2 + L^2}$$

$$\theta_3 = -\operatorname{asin}[(s + s_0 \cos\alpha + r \sin\alpha \cos\theta_1)/L]$$

$$\theta_4 = \operatorname{atan2}[-(r \cos\theta_1 + d_0)/L\cos\theta_3, (r \cos\alpha \sin\theta_1 - s_0 \sin\alpha)/L\cos\theta_3]$$

$$\eta = -\operatorname{asin}[\sin\alpha \cos\theta_3 \sin\theta_4 + \cos\alpha \sin\theta_3]$$

$$\zeta = \operatorname{atan2}\begin{bmatrix}(\cos\theta_1 \cos\theta_3 \cos\theta_4 - \cos\alpha \sin\theta_1 \cos\theta_3 \sin\theta_4 + \sin\alpha \sin\theta_1 \sin\theta_3)/\cos\eta, \\ (-\sin\theta_1 \cos\theta_3 \cos\theta_4 - \cos\alpha \cos\theta_1 \cos\theta_3 \sin\theta_4 + \sin\alpha \cos\theta_1 \sin\theta_3)/\cos\eta\end{bmatrix}$$

$$\xi = \operatorname{atan2}[(-\sin\alpha \cos\theta_4)/\cos\eta, (\sin\alpha \sin\theta_3 \sin\theta_4 - \cos\alpha \cos\theta_3)/\cos\eta]$$

REFERENCES

[1] Fischer, I. S., *Numerical Analysis of Displacements in Spatial Mechanism with Ball Joints*, Mechanism and Machine Theory, Vol. 35, 2000, pp.1623-1640.
[2] Hartenberg, R.S., Denavit, J., *Kinematic Synthesis of Linkages*, McGraw-Hill Book Co., New-York, 1964.
[3] McCarthy, J.M., *An Introduction in Theoretical Kinematics*, MIT Press, 1990.
[4] Yang, A. T., *Application of Quaternions Algebra and Dual Numbers to the Analysis of Spatial Mechanisms*, PhD Thesis, Columbia University, 1963.