Self-Motions of Griffis-Duffy Type Parallel Manipulators

Manfred HUSTY[1] & Adolf KARGER[2]

[1]Inst. f. Mathematics and Applied Geometry, Montan University, Leoben, Austria, e-mail:husty@unileoben.ac.at,
[2]Mathematical Institute of the Charles University, Praha, Czech Republic, e-mail:karger@karlin.mff.cuni.cz

Griffis and Duffy proposed in several papers and an US patent [1] a new type of parallel manipulator. This manipulator (GD-platform) is a special case of the well known Stewart-Gough platform which consists of a base and a platform connected by six ball-joint-ended linear actuators. On base and platform the centers of the ball joints form two sets of attachment points. Giffis and Duffy propose a very special geometry for these two sets of points. On both, base and platform, three points form a triangle and the remaining three points are placed each on one side of the triangle. The connection between base and platform is made in such a way that the points on the sides of the triangle of the base are connected to the vertices of the triangle of the platform and vice versa.

Griffis and Duffy have shown that this type of platform has a relatively simple direct kinematics which admits up to 16 real soutions. A closer inspection of this manipulator reveals that it has some strange and maybe dangerous behaviour. Using an improved version of the direct kinematics algorithm developed in [3] and [2] we will show in this paper

1. One relative simple design condition will make the GD-platform architectural singular (this property says that the manipulator is singular in every point of its workspace).

2. The design condition has nice a geometric interpretation.

3. The GD-platform must obey an assembly condition (if it does not obey this assembly condition then there is no real assembly mode).

4. If the platform obeys the assembly condition than it has a self motion, which means that it is mobile at least with one degree of freedom without changing the actuator lengths.

References

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