EXEMPLARY SELF-MOTIONS OF PLANE-SYMMETRIC EQUIFORM STEWART GOUGH PLATFORMS

Georg Nawratil

Institute of Discrete Mathematics and Geometry, Vienna University of Technology

Wiedner Hauptstrasse 8-10/104, 1040 Wien, Email: nawratil@geometrie.tuwien.ac.at

1 Introduction

In the following we study a concrete example of a plane-symmetric equiform Stewart Gough platform regarding its self-motions, whose theoretical aspects were presented in Section 4 of:

NAWRATIL, G.: *On equiform Stewart Gough platforms with self-motions.* Journal for Geometry and Graphics **17** (2) 163–175 (2013)

All references given and notations used in this discussion are done with respect to this article.

1.1 Fundamentals

The geometry of the plane-symmetric equiform Stewart Gough manipulator given in Example 1 of the above cited publication is determined by:

$$\mu = \frac{\pi}{4}, \quad \lambda = -\frac{3\pi}{4}, \quad c_1 = c_2 = c_3 = -1.$$

For the following choice of leg lengths [1] :

$$R_1^2 = 6, \quad R_2^2 = 4, \quad R_3^2 = 6, \quad R_4^2 = 9, \quad R_5^2 = 7, \quad R_6^2 = 9,$$

the planar sextic, which represents the self-motion, is displayed for $\rho = -1$ and $\rho = 2$ in Fig. 1.

[1] Note that the input data $(\mu, \lambda, c_1, c_2, c_3, R_1, \ldots, R_6)$ is identical with the example given in the supplementary data (including animations) of the publication [NAWRATIL, G.: *Congruent Stewart Gough platforms with non-translational self-motions.* Proc. of the 16th Int. Conf. on Geometry and Graphics, Innsbruck, Austria, August 4–8, 2014], which can be downloaded from the author's homepage `http://www.geometrie.tuwien.ac.at/nawratil`.

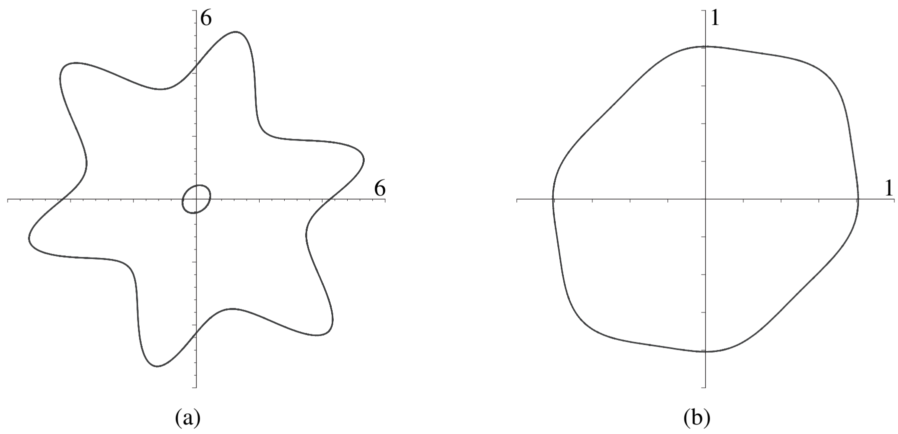

Figure 1: (a) The planar sextic for $\rho = -1$ consists of two components; an "inner" one and an "outer" one. (b) The planar sextic for $\rho = 2$.

1.2 Visualization

All figures and animations are given in one of the following three projections:

- Axonometric view with projection direction $(1, -1, \sqrt{2})$: The labeled base of the manipulator with respect to this projection is given in Fig. 2.
- Top view: The labeled base of the manipulator with respect to this projection is given in Fig. 3.
- Side view with projection direction $(0, 1, 1)$:The labeled base of the manipulator with respect to this projection is given in Fig. 4.

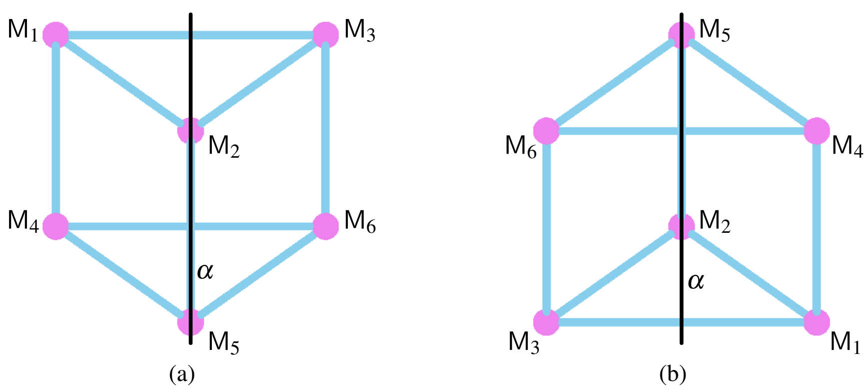

Figure 2: The projection center of the axonometric view is located in a second symmetry-plane α of the base (beside the xy-plane ε), which is given by $x + y = 0$: (a) $\rho = -1$, (b) $\rho = 2$.

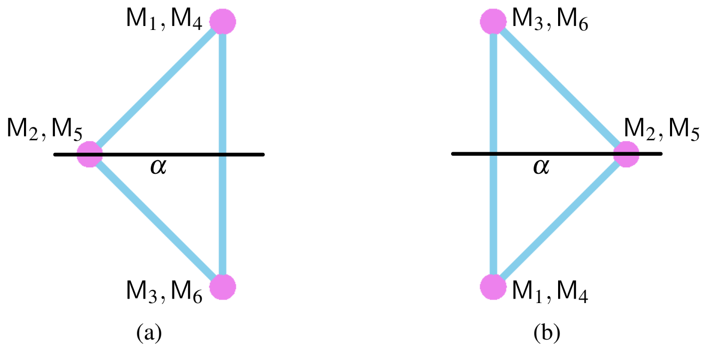

Figure 3: The projection centers of the top view is also located in α: (a) $\rho = -1$, (b) $\rho = 2$.

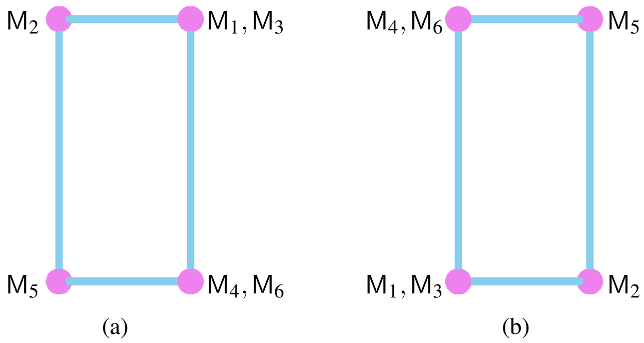

Figure 4: The projection direction of the side view is orthogonal to α: (a) $\rho = -1$, (b) $\rho = 2$.

2 Self-motion for $\rho = -1$

The "inner" and the "outer" self-motion, which are both symmetric with respect to α, are visualized in:

- Animations 1a and 2a: Axonometric view of the "inner" and "outer" one,
- Animation 1b and 2b: Top view of the "inner" and "outer" one,
- Animation 1c and 2c: Side view of the "inner" and "outer" one.

3 Self-motion for $\rho = 2$

This self-motion, which is symmetric with respect to α, is visualized in:

- Animations 3a: Axonometric view,
- Animation 3b: Top view,
- Animation 3c: Side view.