University of Trento
Master in Mechatronics Engineering

*Modelling and Simulation of Mechatronics Systems*

# Development, analysis and optimization of the performance of an innovative driving simulator

**Kinematics analysis**

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The kinematic analysis...

## 1 Kinematics equations

In this section the mechanism's behaviour is studied. In Figure 1 is shown the top view of the mechanism.

Figure 1: Top view of the full-mechanism.

In first approximation a 2D analysis is conduced, and is refered only to the bodies (A) and (B).

### 1.1 2D-kinematics analysis

The mechanism studied in the 2D simplification is the marked part in Figure 1, in fact only bodies (A) and (B) are taken into account, and the result is shown in Figure 2.

Figure 2: 2D mechanism.

For the 2D analysis it is chosen to consider the length of the platform as a constant, even if it could be variable, due to its geometry. More complex analysis are made in the following Section 1.2 during the 3D analysis.

Thanks to this consideration it is possible to say that the full-mechanism is composed by two mirrored sub-mechanisms, made by four sub-bodies, joined by the platform. So the sub-mechanism studied during the 2D kinematic analysis is shown in Figure 3. The same can be done for all the other sub-mechanisms by changing the subscripts.

At a first sight, it is easy to say that the four motors will be the independant variables, they are:

- $s_{A1x}(t)$;
- $s_{A4x}(t)$;
- $s_{B1x}(t)$;
- $s_{B4x}(t)$.

Although the simplicity of this consideration it has to be revisited in way to work together with the previous one: in fact consider the length of the platform (named $L_5$) constant, means that one of the motor has to become a dependant variable.

In particular $s_{A1x}(t)$ is considered the dependant variable.

At the same time has to be defined a set of dependant variables. In particular for the

Figure 3: One of the four sub-mechanism of the structure.

description of the sub-mechanism's behaviour the following elements are chosen:

- $s_{A3x}(t)$ and $s_{A3y}(t)$ which are the space coordinates of the body 3;
- $\theta_A(t)$ which is the angle of the body 2;
- $B_A(t)$ which is the distance of the body 3 from the upper-left edge of the body 4.

### 1.2 3D-kinematic analysis

## 2 Velocity analysis

## 3 Acceleration analysis

## 4 Effects of the main geometrical parameters

## References


[1] "*Advanced Vehicle Driving Simulator*", ABDynamics.

[2] "*6DOF Motion System*", CKAS.

[3] M. Kasim A. J., "*Design and development of 6-dof motion platform for vehicle driving simulator*", Universiti Teknologi Malaysia.