Секція: АВТОМАТИЗАЦІЯ, КОМПЮТЕРНІ ТЕХНОЛОГІЇ ТА РОБОТОТЕХНІКА

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ПЛАНУВАННЯ ТРАЄКТОРІЇ ДЛЯ НИЖНІХ КІНЦІВОК ДВОНОГИХ РОБОТІВ З ВИКОРИСТАННЯМ ПЕРЕВЕРНУТОГО МАЯТНИКА

Мета планування траєкторії полягає в тому, щоб сформувати опорний рух для систем управління рухом двоногих роботів і дати можливість роботові слідувати заданій заданій траєкторії під час руху.

Ключові слова: двоногі роботи, планування траєкторії, 3D слідкування, модель інвертованого маятника

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PLANNING TRAJECTORY FOR THE LOWER LIMBS OF BIPEDAL ROBOT USING INVERTED PENDULUM

The purpose of planning trajectory is to generate a reference motion for the control systems of the movement of the bipedal robot and to enable the robot to follow a given predeifind trajectories during the movement.

Keywords: Bipedal Robots, Planning trajectory, 3D walking, model inverted pendulum

The aim of this paper is to present afull 3D walking strategyusingdynamic model of 3D inverted pendulum for generation references joint trajectories with simulation also design a control system that granites a stable walking of Biped Robot.

This is done by first reviewing the literature about different walking strategies. During this literature review the 3D-Linear Inverted Pendulum Model appeared to be the most interesting strategy for further research.

Also, in scientific research, it is also used as a simple model of the human walk. The 3D-LIPM generate a trajectory for the general CoM from which the joint angles can be computed

The idea of the strategy is simple. It models the human as a linear inverted pendulum with massless rods, which represent the legs, and a point mass at the end of the rods representing the total mass of the body. During walking, there is always at least one foot on the ground which can be seen as stance leg. This stance leg is then modeled as an inverted pendulum. The general closed form solution of the dynamics of the linear inverted pendulum are used to design a trajectory for the center of mass(CoM) for stance leg.

In the trajectory generator, the general solution of the 3D-LIPM is used to prescribe a trajectory. for the CoM of the biped robot AK.

The trajectory of the swing leg is designed by a cosine velocity profile interpolation function. The gait of a biped robot is divided into different phases with each its own function and each it owns initial and desired end position and orientation. Point to point interpolation functions plan a gait between the initial position and orientation posture and the desired end position and orientation posture. By stitching these phases together, trajectories for the CoM

and swing foot are designed. Inverse kinematics is used to convert the CoM and swing foot trajectory into joint trajectories.

The joint trajectories are used as the input for a dynamic model of biped robot in SimMechanics. The proposed control system in simulation are carried out to tune the trajectory such that the dynamic model is able to walk balanced and the robustness of the gait was verified by adding of disturbances. For example, the position of the CoM was increased or decreased and the steps were simulated with different ground levels. These simulations showed that the trajectory is relatively robust Fig.1.

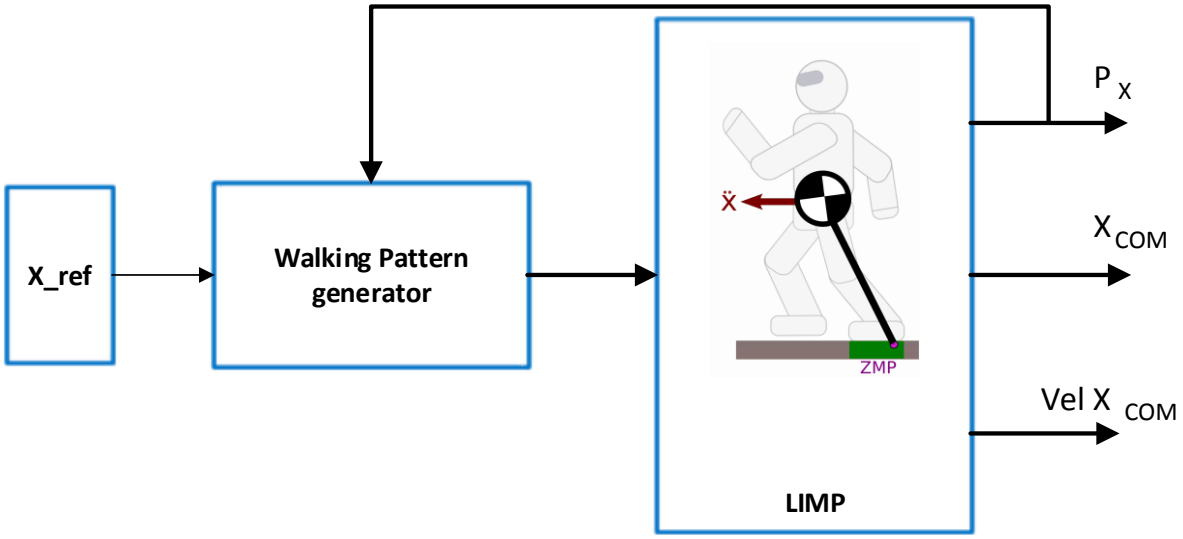

Fig. 1. Simulations trajectory is relatively robust

The trajectory of the Center of Mass along the X axis using linear inverted Pendulum model (LIMP)

For further research on improving a 3D-LIPM trajectory planner for AK robot, it would be interesting to look if it is possible to use a learning control algorithm. The desired steps of AK robot are always the same, and experiments show that also the error repeats every step. This can be used in an iterative learning control architecture.

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