# Kinematic-Dynamic Modeling and Test Control of Tracked Drive Vehicle for Indoor Mapping

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**Abstract.** This paper presents one approach in designing and testing an unmanned ground vehicle (UGV) for indoor mapping. The approach makes use of computer real-time simulation and animation direct with the testing in real environment. Novel control architecture was proposed, by exploit the communication between 2 laptop installed Matlab/Simulink and telemetry data collected from it. The parameter values between real performance and model can be easily evaluated and also from its ladar scanning result, then researcher can explore more variation of modeling aspect, parameter and sensor-actuator configuration to enhance performance of their indoor unmanned vehicle.

## Introduction

The key use of unmanned vehicle is to produce more safety to the human pilot and reduce cost factor, reduce cost factor means the ability that unmanned vehicles have is inversely proportional with the money spends to built it. More advanced unmanned vehicle, lesser money spent expected. From there simulation became more important than trial and error. Simulation is very useful for any kind of aspect, like if we want to analyze performance or algorithm for robot competition [1].

Tracked drive mechanisms are found in many all-terrain vehicles, such as loaders, farm machinery, mining and military. This traction scheme is also useful for off-road mobile robots. Tracked drive vehicle presents 2 major advantages over alternative wheel configuration, such as Ackerman or axle-articulated. First, it is simple and robust in mechanical terms. Second, it provides better maneuverability, including zero-radius turning, using only the components needed for straight-line motion [2].

The rest of this paper is organized as follow. Section 2 describes the fundamental kinematics of UGV. Section 3 describes the dynamics of UGV applied. Section 4 describes control architecture that uses by UGV. Section 5 describes experimental procedure. Section 6 describes the results and discussion. Finally, the summary and future work of our work is described in section 7.

## Kinematics

Most models assume a wheeled mobile robot kinematics only experienced roll motion (rolling) [3]. Some of the assumptions used for the movement of pure rolling or rolling wheels, among others:
- Robot motion is modeled by a simple rigid body kinematics modeling
- Slip does not occur and the friction in the longitudinal direction of rolling movement between the wheels with the floor.

Shown in Fig.1. Adapt from [1] UGV moves on X-Y plane, $V = [u \ v \ 0]^T$ at its center of mass (COM). $u$ is the longitudinal speed and $v$ is the lateral speed. Since the motion is nonholonomic, $v=0$. However, it may rotate with an angular speed $\omega = [0 \ 0 \ r]^T$. If $\dot{q} = [\dot{X} \ \dot{Y} \ \dot{\theta}]^T$ is the state vector representing robot's X-Y The lateral and angular speeds, $u$ and $r$ can be determined by having angular speeds on the left and right drive wheels ,$\omega l$ and $\omega r$