Estimation of attitude via quaternion in an industrial robot

ABSTRACT
Traditionally, the automotive industry has been the largest employer of robots, but their control is inline and programmed to follow planning trajectories. In this case, in the motor's department test of Volkswagen México a semi autonomous robot is developed to generally purpose. Some critical technical problems must be solved in a number of areas, including in dynamics and control. Generally, the attitude estimation and the measurement of the angular velocity are a requirement for the attitude control. As a result, the computational cost and the complexity of the control loop is relatively high. In the present paper, a techniques for attitude stabilization are proposed; the technique proposed is designed with attitude estimation and the prediction of the movement. With this approach, only the measurements of at least two non-collinear directional sensors are needed. Since the control laws are highly simple and a model-based observer for angular velocity reconstruction is not needed, the proposed new strategy is very suitable for embedded implementations. The global convergence of the estimation and prediction techniques are proved. Simulations with some robustness tests are performed.

INDEX TERM$s$
- IEEE Terms
  - Acceleration, Estimation, Mathematical model, Quaternions, Service robots, Vectors
- INSPEC
  - Controlled Indexing
    - angular velocity measurement, attitude control, industrial robots, observers, path planning, sensors, stability, trajectory control
  - Non Controlled Indexing
    - Volkswagen México, angular velocity measurement, angular velocity reconstruction, attitude control, attitude estimation, attitude stabilization, automotive industry, industrial robot, model-based observer, noncollinear directional sensor measurement, quaternion, semiautonomous robot, trajectory planning
- Author Keywords
  - Estimation, Industrial Robot, Prediction of the movement, Quaternion
ESTIMATION OF ATTITUDE VIA QUATERNION IN AN INDUSTRIAL ROBOT


Abstract—Traditionally, the automotive industry has been the largest employer of robots, but their control is inline and programmed to follow planning trajectories. In this case, in the motor’s department test of Volkswagen México a semi autonomous robot is developed to generally purpose. Some critical technical problems must be solved in a number of areas, including in dynamics and control. Generally, the attitude estimation and the measurement of the angular velocity are a requirement for the attitude control. As a result, the computational cost and the complexity of the control loop is relatively high. In the present paper, a techniques for attitude stabilization are proposed; the technique proposed is designed with attitude estimation and the prediction of the movement. With this approach, only the measurements of at least two non-collinear directional sensors are needed. Since the control laws are highly simple and a model-based observer for angular velocity reconstruction is not needed, the proposed new strategy is very suitable for embedded implementations. The global convergence of the estimation and prediction techniques are proved. Simulations with some robustness tests are performed.

Index Terms—Estimation, Quaternion, Prediction of the movement, Industrial Robot.

Robots have considerable potential for application in Volkswagen plants. Looking at the four major sectors of a vehicle assembly operation, as follow:

1) PRESS. As VW has installed high-speed presses with integral part handling.
2) BODY. They are seeking for robots that provide speed, accuracy, more payload capacity and are easy to integrate.
3) PAINTING. In this area an extensive use of robots in the painting is done, the future shouldn’t look different from the present.
4) ASSEMBLY. In this area they want to see robots that have the abilities to do such things as see and feel.

In the motor’s test area, the assembly of all of the instrumentation and wiring systems is done, semi autonomous robotic and telerobotic systems have been considered for the different test (Fig. 1).

To date, some critical technical problems must be solved in a number of areas, including dynamics and control. A number of the dynamics and control problems faced by the designers of mobil robotic systems is unique to this area, because of the distinctive and complex dynamics found in many potentially important applications. This paper focuses on these problems. The paper considers