RACbot-RT

RACbot-RT: Robust Digital Control for Differential Soccer-Player Robots

By:
João Monteiro and Rui Rocha
jmonteiro@alunos.deec.uc.pt,
rprocha@deec.uc.pt

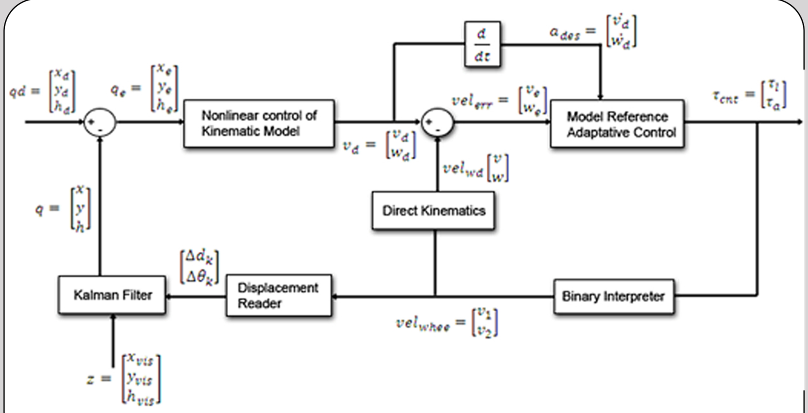
Introduction:

A digital controller suitable for the RAC robotic soccer team was developed within this project. In order to endow our mobile robots with the ability of reaching accurately a given target set-point, a feedback control loop possessing adaptive control laws to deal with modeling errors, as well as a Kalman filter which fuses vision with odometry, is presented.

Objectives:

- Development of a generic control scheme.
- Minimization of modeling errors.
- Simplicity and full functionality.
- Build a dynamic control module for RACmotion.
- Fuse sensorial data available to boost accuracy.
- Real-time implementation.

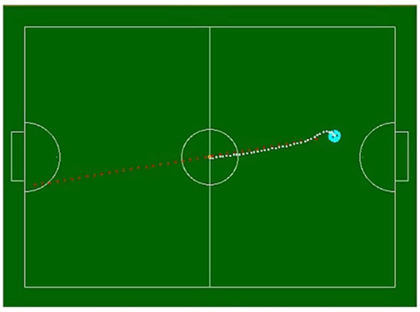
Control Scheme:



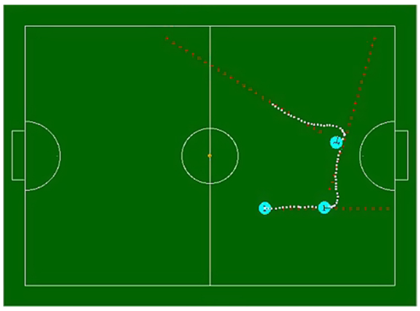
Control Modules:

- **Nonlinear Control of Kinematic Model:** calculates the desired angular and linear velocities vector, based on the pose error and on the reference velocities. It uses Lyapunov nonlinear control laws.
- **Model Reference Adaptative Control:** deals with measurement errorsn mass and inertia, which are structure dependent parameters. This block gives us the power to make a simple, yet robust controller with proved convergence to stability, and pose error elimination. As the desired torques are calculated, its value is continuously adjusted.
- **Torque Interpreter:** computes the velocity of each wheel based on the actual binary of the rotor. It is necessary for direct kinematics calculation of the platform velocities refered to the world coordinates.
- **Displacement Reader:** computes the angular and linear displacements between the last sample and the actual measurement.
- **Kalman Filter:** produces the final and most important output, the actual robot pose referred to the world reference frame. The trade-off between simplicity and robustness is achieved by fusing odometry and vision measurements.

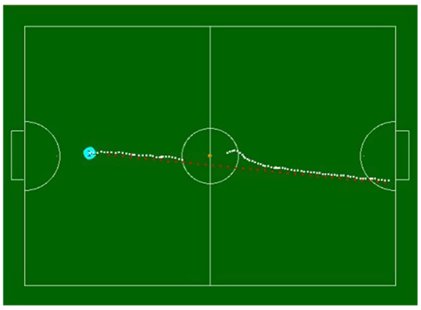
Experimental Results:



`setPoint` to (0,0).



Sequence of `setVelocity` commands.



Vision feedback interrupted within the `setVelocity` command.

Conclusions:

- A robust, simple, and generic controller was developed.
- Ability to handle with model uncertainties.
- Pose estimation is accurate.
- Practical results show total functionality and dynamics of the software control module.

INSTITUTO DE SISTEMAS E ROBÓTICA
UNIVERSIDADE DE COIMBRA
FCTUC FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE DE COIMBRA
DEEC
DEPARTAMENTO DE ENGENHARIA ELECTROTÉCNICA E DE COMPUTADORES