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Longitudinal and lateral slip control of autonomous wheeled mobile robot for trajectory tracking

Key words: Robot modeling, Robot navigation, Slip and skid control, Wheeled mobile robots

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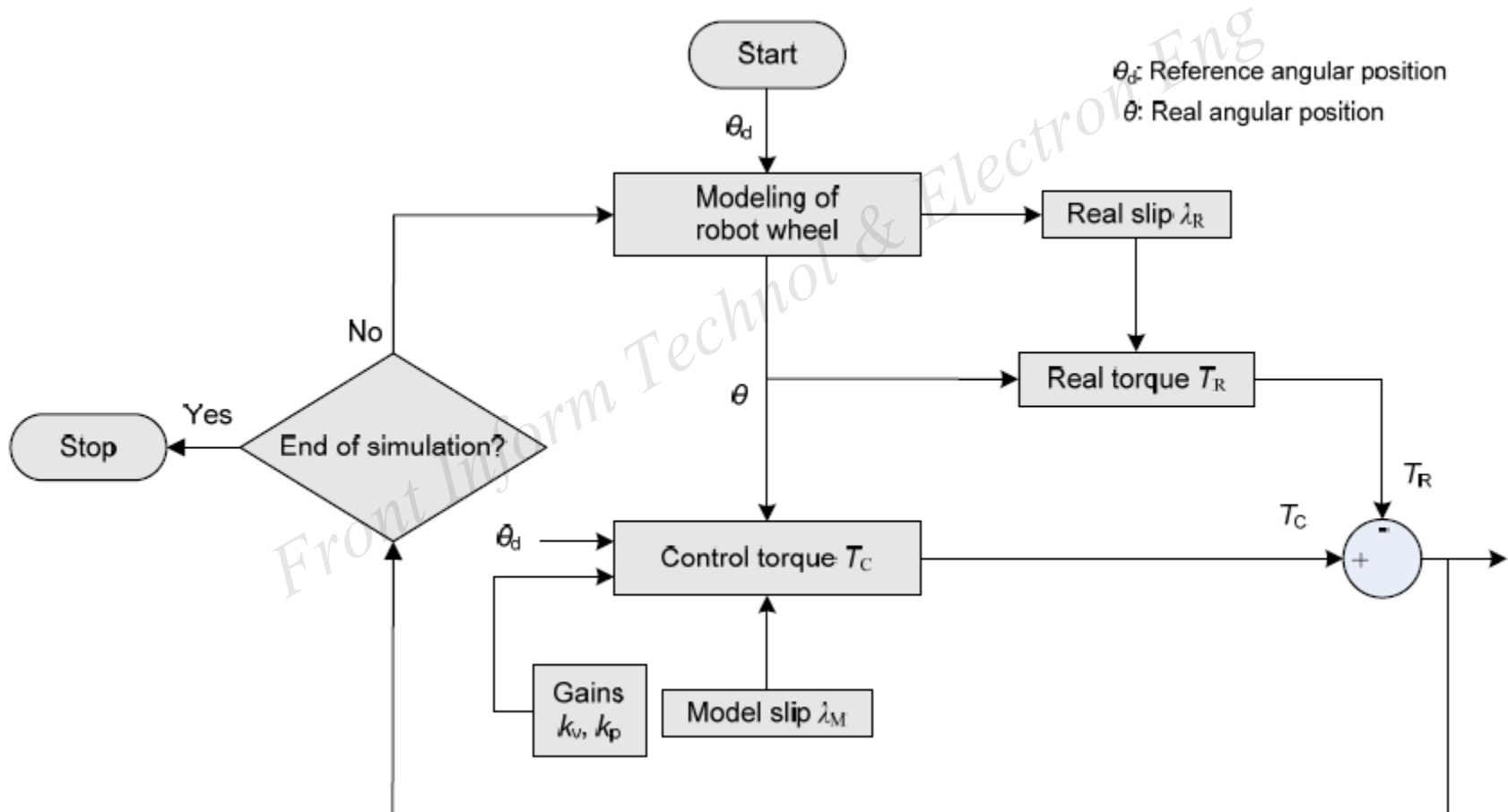
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Introduction

- This research focuses on controller design for longitudinal slip control. Lateral motion slip or skid is also briefly addressed.
- Car-like wheeled mobile robot (WMR) has been considered.
- Longitudinal slip model has been derived followed by synthesis of logic-based controller to mitigate slippage.
- Various control parameters have been studied to investigate their effects on the performance of the controller resulting in selection of their optimum values.

Longitudinal slip control law



Controller response under various natural frequencies

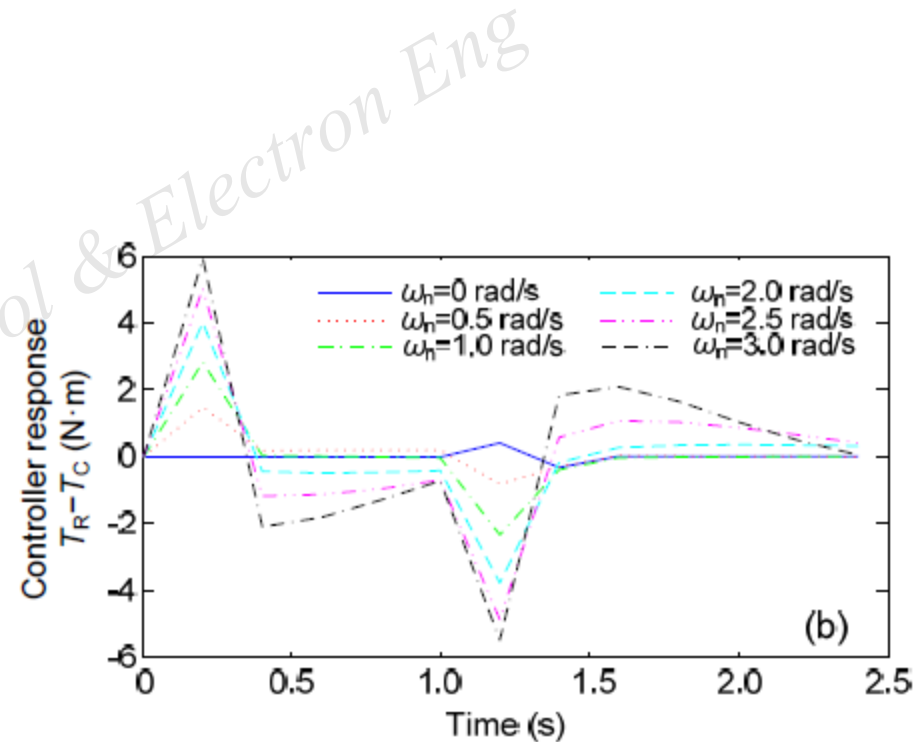
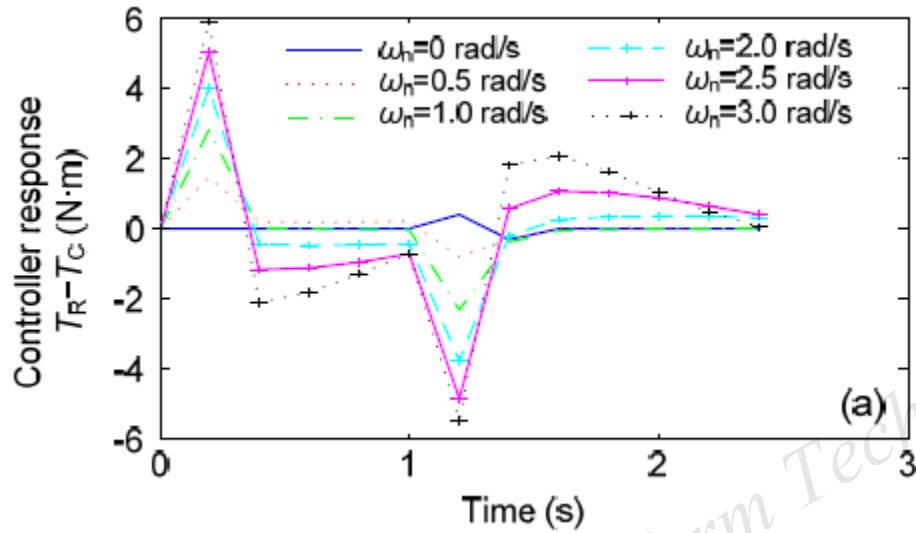


Fig. 4 Controller responses under various natural frequencies

(a) $m=1$ kg, $r=0.03$ m; (b) $m=5$ kg, $r=0.1$ m

Controller response under various damping ratios and masses

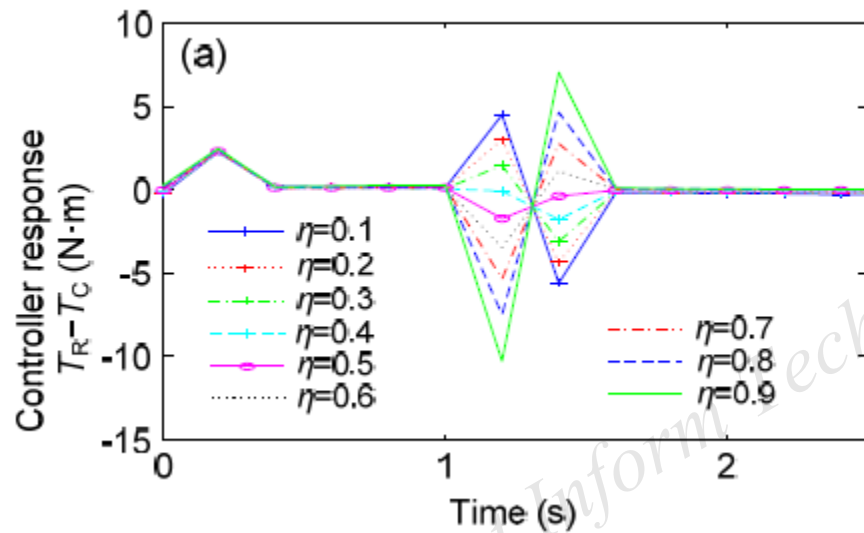
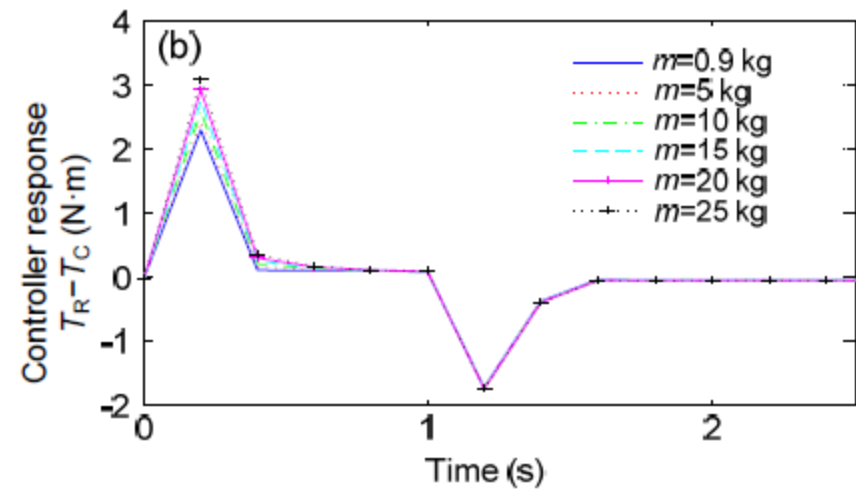
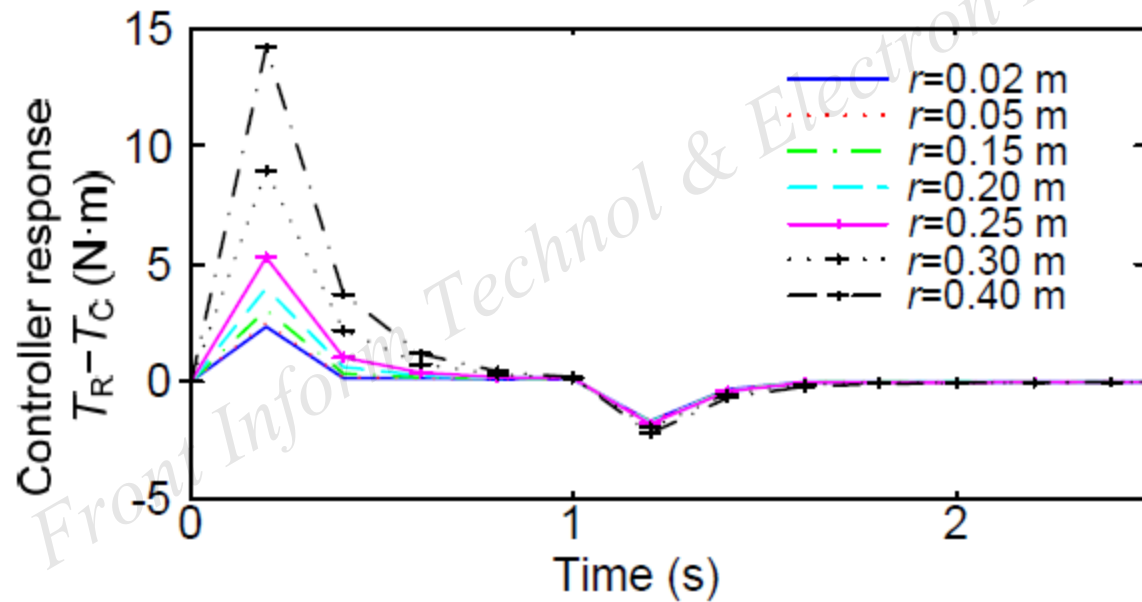


Fig. 5 Controller responses under various damping ratios (a) and masses (b)



Controller response under various radii



Optimum selection of control parameters

m/r (kg/m)	ω_n (rad/s)	η	m/r (kg/m)	ω_n (rad/s)	η
0.5/0.01	0.67	0.41	5.0/0.06	0.75	0.59
0.9/0.02	0.73	0.53	7.0/0.10	0.66	0.76
1.0/0.03	0.69	0.51			

Conclusions

- Simulation results validated the efficiency of the proposed slippage scheme.
- Tests have been conducted to select suitable parameters for the controller to achieve faster and smoother response.
- We have achieved uniform boundedness with exponentially converging errors without imposing restrictive assumptions on the skidding and slipping perturbations.