

INTELLIGENT ACTIVE FORCE CONTROL
FOR MOBILE MANIPULATOR

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DEDICATION

To my parents,

Almh. Hj. Mariyati binti Saderi

Alm. H. Sam Pitoyo bin Hassan

To my beloved family,

Veraini Windiana

Ivorie Rahiema Verandra Asyigah

Akbar Hakim Pitoabrory

Ramdhan Hakim Pitoabrory

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ABSTRACT

This thesis presents a resolved acceleration control (RAC) and intelligent schemes of active force control (AFC) as approaches for the robust motion control of a mobile manipulator (MM) comprising a differentially driven wheeled mobile platform with a two-link planar arm mounted on top of the platform. The study emphasizes on the integrated kinematic and dynamic control strategy in which the RAC is used to manipulate the kinematic component while the intelligent schemes are implemented to compensate the dynamic effects including the bounded known/unknown disturbances and uncertainties. The proposed intelligent schemes are based on iterative learning control (ILC) and knowledge-based fuzzy (KBF) strategies. The effectiveness and robustness of the proposed schemes are investigated through a rigorous simulation study and later complemented with experimental results obtained through a number of experiments performed on a fully developed working prototype in a laboratory environment. A number of disturbances in the form of applied constant, vibratory and impact forces are deliberately introduced into the system to evaluate the system performances. The investigation clearly demonstrates the extreme robustness feature of the proposed control schemes compared to other systems considered in the study.

ABSTRAK

Tesis ini membincangkan suatu kaedah kawalan pelerai pecutan (RAC) dan kawalan pintar daya aktif (AFC) yang lasak terhadap sebuah robot pengolah mudah gerak (MM) melibatkan sebuah pelantar beroda yang dipacu pacu secara pembezaan dan mudah alih bersama dengan sebuah pengolah lengan planar dua-sendi yang dipasang di atas pelantar. Kajian ini mengutamakan gabungan strategi kawalan kinematik dan dinamik yang mana RAC digunakan untuk mengolah komponen kinematik manakala skema AFC diterapkan untuk memampas kesan dinamik termasuk gangguan dan keadaan tak menentu. Skema pintar yang dicadangkan adalah berasaskan strategi kawalan pembelajaran berlelaran (ILC) dan kaedah logik kabur berasaskan pengetahuan. Kebolehan dan kelasakan skema yang dicadangkan dikaji dan diuji melalui kaedah simulasi dan seterusnya ditentusahkan melalui hasil eksperimen yang dibuat menggunakan sebuah prototaip robot pengolah mudah gerak yang dibina di dalam makmal. Sejumlah gangguan berupa daya malar, getaran dan dedenyut dikenakan kepada sistem robot untuk meneroka kebolehan dan keberkesanan sistem. Hasil simulasi dan eksperimen menunjukkan kelasakan dan keberkesanan skema kawalan yang dicadangkan berbanding dengan sistem lain.