Introduction

Multi-legged robots are preferred to wheeled ones for moving through the terrains, which generally do contain some irregularities, as the former have better mobility compared to the latter. However, the poor state of the art of multi-legged robot technology is mainly due to low energy efficiency along with the fact that walking robots entail more complex linkage systems than other mobile robots do. Therefore, energy consumption and stability analysis play key roles in the design and development of six-legged robots.

In order to analyze energy consumption of legged robots, it is necessary to have good models describing the kinematics and dynamic behavior of the complex multi-legged robotic system composed of multiple chains forming closed kinematics loops. A considerable amount of work had been carried out by various investigators on kinematics, dynamics and stability analysis of six-legged robots. The most of the studies on walking dynamics were conducted with simplified models of the legs and body. However, in order to have a better understanding of its walking; kinematics analysis and dynamic modeling based on a realistic walking robot are necessary to carry out. Different approaches like optimal selection of gait parameters, optimum solution to foot force distribution had been used by various researchers to achieve energy efficiency in statically stable multi-legged robots.

Although the above attempt could find the optimal values of feet forces of the multi-legged robot, they might not be suitable for real-time implementations, because the used optimization techniques were iterative in nature. Thus, there is still a need for the development of an energy efficient and computationally tractable approach for the estimation of optimal feet forces and torques. The studies on crab and turning gaits did not receive much attention till date, although these are important for omni-directional walking robots, which are more complicated compared to the straight-forward gaits.

In the present thesis, an analytical approach has been developed first to study the kinematics and dynamics along with energy efficiency and stability analysis of a realistic six-legged robot, negotiating straight-forward, crab and turning motions. An attempt has also been made to study the effects of walking parameters, namely stroke, velocity and duty factor on energy consumption and stability margin of the six-legged robot.

Soft computing-based models have also been developed to predict energy consumption and stability margin for generating various gaits of the six-legged robot. The developed soft computing-based approaches have been compared in terms of their accuracy in predictions, so that the best one can be identified.