Abstract of Main Thesis

Title of Thesis

Study on Motion Modes of an Eccentric Paddle Mechanism for Accessing Amphibious Terrains

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Abstract on the Content of the Applicant's Thesis

Attacked by natural disasters, such as large-scale earthquakes, floods and tsunamis, lives are killed and victims are trapped in large areas where full of collapsed and submerged buildings and cars exist. Victim searches and subsequent rescue operations in such amphibious environments are extremely difficult and dangerous for human teams. Unfortunately, most of recently developed rescue robots are still not qualified for giving robotic assistances after the tsunamis and floods, due to their limited mobility and maneuverability on the amphibious terrains.

In this study, inspired by animals habiting in aquatic and amphibious environments, we propose a novel eccentric paddle mechanism (ePaddle) by integrating a set of eccentrically placed paddles into a traditional wheel, and introduce paddle-aided locomotion principles for achieving agile, stable and versatile robotic motion on amphibious terrains. Based on analysis of the ePaddle mechanism, kinematics of the ePaddle mechanism is firstly established. These models result the discoveries of six kinds of essential motion modes of the ePaddle mechanism, including the wheeled rolling, wheel-paddle-integrated rolling, legged crawling, legged race-walking, rotational paddling and oscillating paddling modes, which are novel and useful for the amphibious mobile robot.

Based on the kinematic models of the ePaddle mechanism, standard motion sequences for each of these motion modes of a single ePaddle module are defined and experimentally tested on a prototype module. Performance analysis of these motion modes verified the versatility and mobility of the proposed ePaddle mechanism and showed the advantages of the paddle-aid motion in improving the mobility and endurance of the mobile robot. The proposed ePaddle mechanism can be thus deployed as an enhanced wheel to replace the traditional wheels in existing mobile robots for accessing amphibious terrains, which are inaccessible for robots using traditional legged, wheeled or tracked mechanisms.