

# **Conceptual Design and Control of Walking and Transportation Assist Devices Considering Human Motion**

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# Abstract

Nowadays, lacking in adequate care for the elderly, especially those who are walking with inconvenience is becoming a growing problem for the aging society. According to this problem, this thesis presents three solutions to help the elderly or patient walk and move more conveniently and easily from three different aspects. All of them are intended to help the elderly or patient walk or move independently.

Chapter 1 presents the motivation and related works.

Chapter 2 introduces the human motion measurement method by inertial sensors. The developed measurement method is utilized for sophisticated control of assist devices.

Chapter 3 explains the disturbance observer (DOB), reaction torque observer (RTOB) and synthesized camber angle disturbance observer (SCOB). They are utilized to control the proposed devices accurately and robustly.

From chapter 4 to chapter 6, the conceptual design and control of the three walking and transportation assist devices are introduced. Different design objectives for the three solutions are summarized below.

Chapter 4 describes the multi-legged walking assist device (approach 1) focusing on preventing the elderly fall down and enhancing their walking ability, it is suitable for the elderly or patient who have very poor walking ability. The moving speed is the slowest correspondingly.

Chapter 5 shows the walking assist cart operated by human foot (approach 2) that focuses on giving a hand to the elderly when they walking. It is suitable for the elderly or patient who have a better walking ability but cannot walk without walking assist devices. The device easily moves beside the user and coordinate with his or her steps, and moving speed is depend on the users' habits.

Chapter 6 presents the self-balancing two-wheel electric motorcycle (approach 3) focusing on providing a fast and safe transportation solution for the elderly or patient. It can keep self-balancing not only at high speed but also at low and zero speed. It is suitable for the elderly or patient who have a better walking ability and want to move fast. Its moving speed is the fastest correspondingly.

Although these researches are still relatively immature, they can provide solutions to help the elderly or patient move more conveniently and easily in the future society. The major contributions of them is providing some novel ideas, designs and control methods to help the elderly or patient who want to walk or move conveniently and independently.

Chapter 7 concludes the thesis and provides a summary of the major results and contributions of this work. Also, a discussion of directions for future work is provided finally.