



The 7th International Conference on Ambient Systems, Networks and Technologies
(ANT 2016)

Homogeneity and activeness of crowd on aged pedestrian dynamics

Jun Zhang^a, Shuchao Cao^{b,*}, Daniel Salden^a, Jian Ma^c

^a*Forschungszentrum Jülich GmbH, Institute for Advanced Simulation, 52425 Jülich, Germany*

^b*State Key Laboratory of Fire Science, University of Science and Technology of China, Hefei, 230027, China*

^c*School of Transportation and Logistics, Southwest Jiaotong University, Chengdu, 610031, China*

Abstract

An aging population is bringing new challenges to the management of escape routes and facility design in many countries. In this paper the movement properties of middle- and old-aged adults are studied with series of single-file movement experiments under laboratory conditions. The fundamental diagrams for two different groups of pedestrians and time-space diagrams are compared. For the groups with different composition and status, the fundamental diagrams are totally different but maintain the same trend. Active crowd leads to inhomogeneous pedestrian flow but higher flow rate, while inactive pedestrians prefer to keep pace with others or keep larger personal space, which leads to more jams and stop-and-go waves. Density and inhomogeneous of speed do not always play main roles on the appearance of stop-and-go.

© 2016 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the Conference Program Chairs

Keywords: Aging effect; Pedestrian dynamics; Single-file flow; Stop-and-go; Aged crowd;

1. Introduction

In recent years, several crowd disasters occur all over the world. For example, the stampede at the 2010 Love Parade electronic dance music festival in Duisburg in Germany caused the death of 21 people and at least 510 more were injured. To avoid such kind of accidents and improve the safety of pedestrians, good understanding on

* Corresponding author. Tel.: +86-551-63606419; fax: +86-551-63601669.

E-mail address: sccao@mail.ustc.edu.cn

pedestrian dynamics, reasonable design of public facilities and effective management of events are of great importance. Even for the basic fundamental diagram, however, large discrepancies are shown in previous studies^{1,2}. It is affected by several factors including pedestrian motivation, facility geometry, culture differences etc. Besides, Aging population, increasing obesity and more people with mobility impairments are bringing new challenges to the management of routine and emergency people movement in many countries. The movement properties of pedestrian crowds with different ages are crucial to be considered in pedestrian dynamics studies. Some models considering the movement characteristics of different age groups are built. Tang et al.³ proposed a cellular automata model for pedestrian flow to investigate the effects of elementary students' individual properties on the evacuation process in a room with two exits. Galiza et al.⁴ employed a micro-simulation approach to investigate the potential effects of increased proportion of older people in pedestrian flow and on the level of service criteria. Koo et al.⁵ studied how seriously residents with disabilities affect the evacuation of other residents in a high-rise building environment through an agent-based model. Kholshchevnikov et al.⁶ investigated the evacuation of children from pre-school educational institutions. Pre-movement time and the relationships between density and speed during upward and downward movement were analyzed for children. Cueta et al.⁷ carried out evacuation experiments in a school building with children from 6 to 16 years old. Regarding to old pedestrians, however, only few studies can be found. Kuligowski et al.⁸ conducted an evacuation experiment with older adults and disabled residents descending the stairwells. Shimura et al.⁹ studied the mobility of the aged pedestrians by experiment and simulation. More detailed movement properties of middle- and old-aged adults are necessary to be considered in pedestrian dynamics studies in the future.

Single-file pedestrian flow involving purely longitudinal interactions among pedestrians could be a good start for studying such problems. The possible influences on the flow in this case have been studied from various aspects with young test persons. Seyfried et al.¹⁰ measured the fundamental diagram of single file flow for densities up to 2 m^{-1} . Similar experiments were also carried out in India by Chattaraj et al.¹¹ and in China by Liu et al.¹² to investigate the culture difference on the fundamental diagram with university students. In France Jelic et al. conducted experiment inside a ring formed by inner and outer round walls to study the properties of pedestrians moving in line¹³. The density in their experiment reaches 3 m^{-1} and the stepping behavior and fundamental diagrams are studied. From the study, three regimes (free regime, weakly constrained regime and strongly constrained regime) are distinguished by analyzing the velocity-spatial headway relationship. Stop-and-go wave¹⁴ as a special phenomenon of congested flow is observed from the experiment with soldiers and pupils in Germany.

In this paper we will study the movement properties of middle- and old aged-adults. The remainder of the paper is organized as follows. In Section 2 we describe the setup of the experiments. Section 3 analyzes the characteristics of pedestrian movement based on trajectories extracted from video recordings and shows the main results. Finally, the conclusions from our investigation will be discussed.

2. Experiment setup

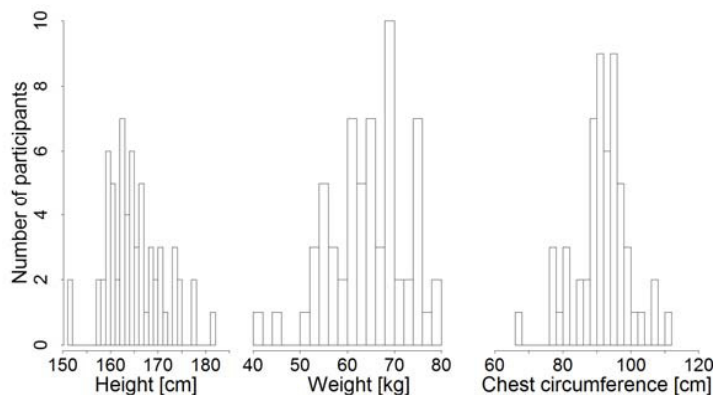


Fig. 1. Distribution of heights, weights as well as chest circumference of test persons.

Download English Version:

<https://daneshyari.com/en/article/485377>

Download Persian Version:

<https://daneshyari.com/article/485377>

[Daneshyari.com](https://daneshyari.com)