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Shuqi Xue, Bin Jia, Rui Jiang, Xingang Li, Jingjing Shan

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1 # *An improved Burgers cellular automaton model for bicycle flow*

2 **Shuqi Xue, Bin Jia[*], Rui Jiang, Xingang, Li, Jingjing Shan**

3 MOE Key Laboratory for Urban Transportation Complex Systems Theory and
4 Technology, Beijing Jiaotong University, Beijing, China

5 **Abstract**

6 As an energy-efficient and healthy transport mode, bicycling has recently attracted
7 the attention of governments, transport planners, and researchers. The dynamic
8 characteristics of the bicycle flow must be investigated to improve the facility design
9 and traffic operation of bicycling. We model the bicycle flow by using an improved
10 Burgers cellular automaton model. Through a following move mechanism, the modified
11 model enables bicycles to move smoothly and increase the critical density to a more
12 rational level than the original model. The model is calibrated and validated by using
13 experimental data and field data. The results show that the improved model can
14 effectively simulate the bicycle flow. The performance of the model under different
15 parameters is investigated and discussed. Strengths and limitations of the improved
16 model are suggested for future work.
17

20 **1. Introduction**

21 Bicycling, as an energy-efficient, non-polluting, and healthy transport mode, was
22 previously recognized as the major transport mode in many cities of China. In the 1990s,
23 more than 50% of all trips in Beijing were made through bicycles, and less than 0.3
24 million motor vehicles were used at that time. However, with China's rapid economic
25 boom, the car ownership soared and led to a continuing decline in bicycle use. The
26 bicycle mode share fell by nearly 30% in Beijing over the period 1986 to 2007 while the
27 number of motor vehicles increased from 1.51 million to 3.07 million; in Guangzhou,
28 the number of bicycle trips dropped rapidly from 34.1% in 1984 to 10.4% in 2005; in
29 Shenzhen, from 1995 to 2007, the bicycle mode share plummeted from 30% to 4.7% [1,
30 2]. Some European countries such as the Netherlands, Denmark, and Germany also
31 experienced such a sharp fall in bicycle use during the 1950s and 1960s. But due to the
32 policy reform that was meant to promote cycling and restrict car use, a bicycling
33 renaissance turned up in these countries since the mid-1970s [3]. At present, the
34 governments of many large cities in China have begun to rethink the car-oriented policy
35 and shift the focus to the use of new-energy vehicles and shared bicycles [4], to ease the
36 suffering from the rapid increase of motorized vehicles, such as traffic congestion,
37 traffic-related air pollution, and traffic accidents. Consequently, bicycle traffic has also
38 attracted academic attention.
39 Bicycle traffic researchers can be primarily divided into three groups: (i)
40 Researchers who centered their attention on how bicycling could be promoted. They
41 tried to explore the potential effects of various interventions on bicycling promotion
42 through case studies and survey [5-10]. (ii) Researchers who were devoted to bicycle
43 safety. They tried to investigate how cyclist behavior along with environmental