Bauhaus-Universität Weimar
ARCHITECTURE AND URBANISM

DISSERTATION

FORM-ACTIVITY-MOVEMENT INTERACTION MODEL

Study of the interactions between urban form, allocation of activities and pedestrian movement in Weimar, Germany

Doctoral candidate: Ing.Arch Martin Bielik

Supervisors:
Prof. Dr.-Ing. Dirk Donath (Computer Science in Architecture)
Vertr.-Prof. Dr.-Ing. Sven Schneider (Computer Science in Architecture)

1. Background & Problem statement

This dissertation investigates the interactions between urban form, allocation of activities, and pedestrian movement in the context of urban planning. With urban morphologists, urban economists, and transportation planners taking part in the urban planning process, we observe multitude of approaches, each focusing on different part of the form-activity-movement interaction (FIgure 1). Even though there is no doubt about the advantages of these highly focused approaches, **it remains unclear what is the cost of ignoring some interactions while estimating the effect of others**.

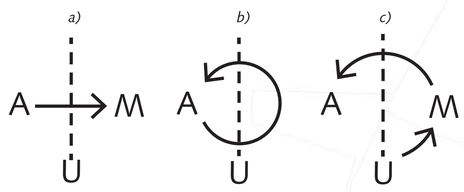

Figure 1. Individual urban form(U) - activity(A) - movement(M) interaction models considered by
a) transportation planners,
b) urban economists and
c) configuration urban morphologists

2. Research Hypothesis

» Estimating the effect of urban form on activities and movement in isolation leads to bias. «

3. Methods

We devised a joined form-activity-movement interaction model (Figure 2) and conduct a large-scale empirical study in Weimar, Germany. In the course of the form-activity-movement model calibration, we identify six activity types relevant as an attractor of pedestrian movement and two distinct processes driving their allocation.

We devised a novel two-stage Filter-Amplifier statistical model for estimating the effect of movement on activity allocation. Finally, to estimate the effect of urban form and activities on movement, we adopt a special version of a linear regression, which guarantees that only positive movement estimates are allowed.

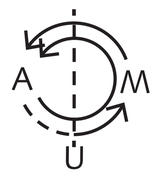

Figure 2. Joined urban form(U)-activity(A)-movement(M) interaction model

4. Results & Conclusions

For all form-activity-movement interactions, we were able to show that when estimated in isolation, the resulting predictions are biased. To illustrate the significance of the bias, we found that if the effect of urban form on movement is assessed without considering the allocation of activities, it is overestimated by 616%.

We do not question the knowledge brought by transportation planners, urban morphologists, and urban economists. We argue, however, that it might be of little use on its own. Our findings suggest that the way how Piketty addresses economist applies to professionals concerned with urban planning as well.

"They must set aside their contempt for other disciplines and their absurd claim to greater scientific legitimacy, despite the fact that they know almost nothing about anything."

(Piketty, 2017, p41).

5. Relevance

1) We quantified the limitations of current methods used to evaluate the effect of long-term urban planning decisions on pedestrian movement and allocation of activities.

2) We proposed an alternative joined form-activity-movement model and demonstrated how it could be utilized to:

2.1) Estimate how often and how far people walk based on where they live and how the movement flows are distributed across space (Figure 3).

2.2) Quantify the potential given by pedestrian movement to accommodate various types of activities. By quantifying the gap between the potential and the actual activity intensity, we can assess the neighborhood's unutilized capacity to accommodate activities, explore its causes, and devise actions to alleviate it.

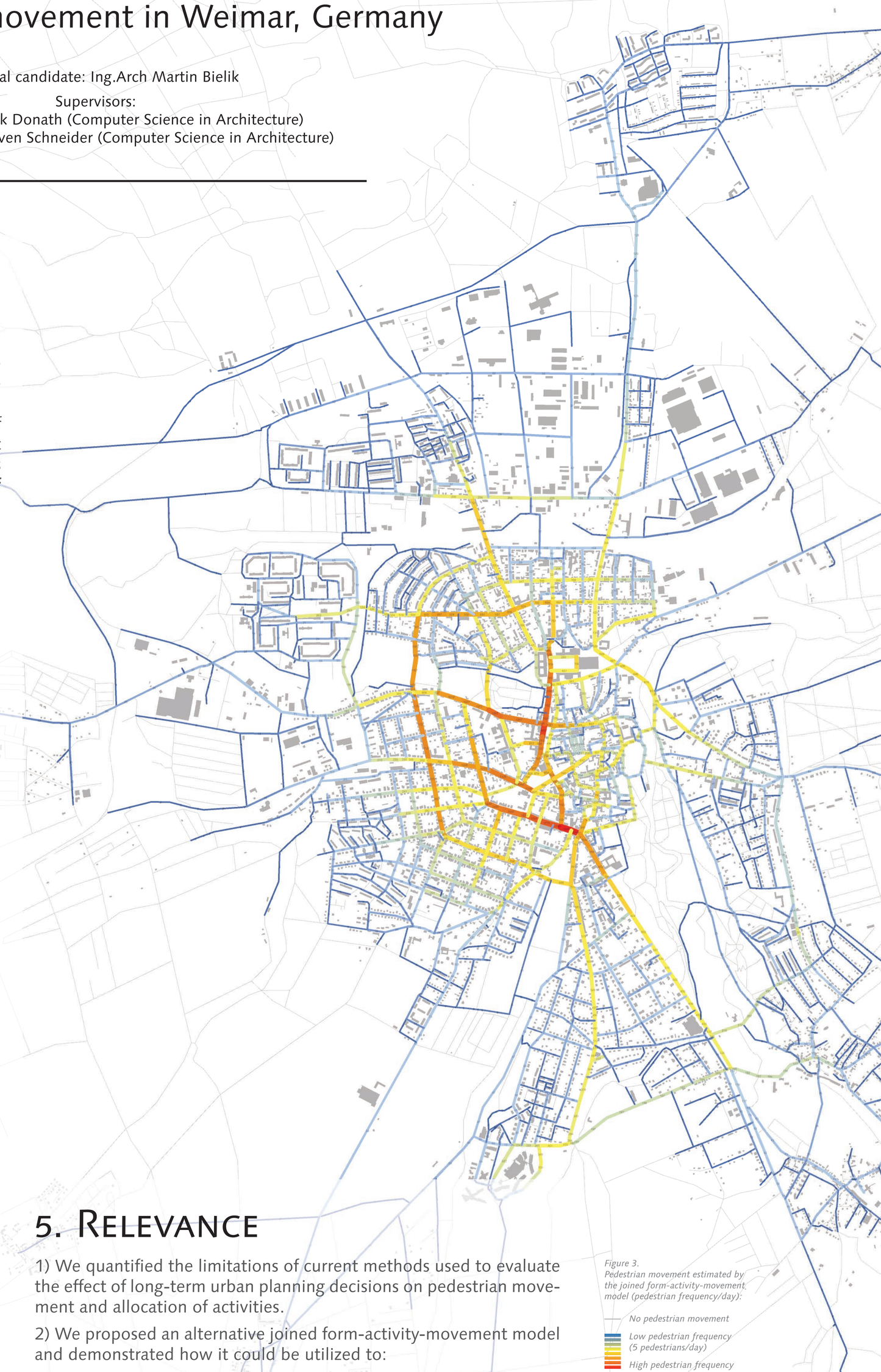

Figure 3. Pedestrian movement estimated by the joined form-activity-movement model (pedestrian frequency/day):
No pedestrian movement
Low pedestrian frequency (5 pedestrians/day)
High pedestrian frequency (2000 pedestrian/day)

References: Piketty, T. (2017). Capital in the Twenty-First Century. Harvard University Press.
Funding: This research was funded by Ernst-Abbe-Stiftung.

WISSENSCHAFTSTAG 2020
18. November
live & digital
Stimme für das Poster online ab!
Vote for this poster online!
www.uni-weimar.de/postercontest