



## **Urban road systems: Self-organised geographical networks with universal geometric features**

S.H.Y. Chan (1), R. Donner (1), S. Lämmer (1), and D. Helbing (2)

(1) Dresden University of Technology, Institute for Transport and Economics, Dresden, Germany (donner@vwi.tu-dresden.de, 0049 351 46336809), (2) ETH Zürich, Switzerland

Human activity patterns have a multiplicity of direct links with contemporary geoscientific problems, for example, in terms of land-use due to growing urban areas, or greenhouse gas emissions due to transportation processes. Typically, the individual transportation processes are bound to a substrate (for example, a road system) which is organised as a complex network.

This work is focussed on the specific properties of urban road networks. For this purpose, we have investigated the road systems of the 20 largest cities of Germany. As in the case of two-dimensional spatial networks, the main features describing their evolution and constraining the dynamics on these networks are directly related to their geometry, this study is focussed on the consideration of measures relating to the physical dimensions of the objects arising due to the segmentation of the geographical space. Surprisingly, although the historical development of the 20 cities as well as their general morphology may be very different, the distributions of characteristic quantities like road lengths and angles as well as the sizes and forms of the resulting "cells" are found to show a high degree of universality. Our corresponding findings suggest that the formation of urban road networks can be understood as a self-organisation process that is governed by a low number of deterministic rules.