"The Mathematics of Public Security" (MAPUSE)
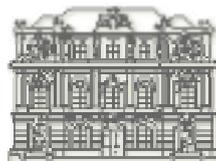
April 7th, 2006
Austrian Academy of Sciences (ÖAW)
http://www.oeaw.ac.at/
Austria, A-1010 Vienna, Dr. Ignaz Seipel-Platz 2

[Status: 27 March 06]

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iWM ORDYS
Institut für Wirtschaftsmathematik
Operations Research und nichtlineare dynamische Systeme

TU WIEN

TECHNISCHE UNIVERSITÄT WIEN

VIENNA UNIVERSITY OF TECHNOLOGY

List of Speakers/Authors
(In Alphabetical Order)

Doris Behrens   *Vienna University of Technology*

Carlos Castillo-Chavez   *Arizona State University*

Jonathan P. Caulkins   *Carnegie Mellon University in Qatar &*
                           Heinz School

Gustav Feichtinger   *Vienna University of Technology*

Joshua R. Goldstein   *Princeton University*

Dieter Grass   *Vienna University of Technology*

Gottfried Haber   *University of Klagenfurt & Ludwig Boltzmann*
                           Institute for Economic Policy Analyses, Vienna, Austria

Edward H. Kaplan   *Yale School of Management*

Andreas Karcher   *Federal Armed Forces University Munich*

Emil Kelevedjiev   *Bulgarian Academy of Sciences*

Tobias Lehmann   *Federal Armed Forces University Munich*

Warwick J. McKibbin   *Australian National University, Australia &*
                           The Brookings Institution, Washington, DC

Zlatogor Minchev   *Bulgarian Academy of Sciences*

Reinhard Neck   *University of Klagenfurt*

Stefan Pickl   *Federal Armed Forces University Munich*

Edieal Pinker   *University of Rochester*

Gernot Tragler   *Vienna University of Technology*

Tsvetomir Tsachev   *Bulgarian Academy of Sciences*

Peter Waldmann   *University of Augsburg*

Preliminary Program

09:00 - 09:10   Opening by a Member of the Austrian Academy of Sciences

09:10 - 10:05   C. Castillo-Chavez:
            "Epidemiological Approaches and Public Security"

10:05 - 11:00   E. Kaplan:
            "Modeling Suicide Bombing and Related Terrorism"

11:00 - 11:20   Coffee Break

11:20 - 11:45   D. Grass:
            "Is it important to manage public opinion while fighting terrorism?
                An optimal control approach"

11:45 - 12:05   G. Tragler:
            "For Sand or Saud: Modeling Strategic Interactions in Counter-
                Terror Operations"

12:05 - 12:35   R. Neck:
            "Terrorism and Macroeconomic Policies in the US and Europe"

12:35 - 14:00   Lunch Break

14:00 - 14:20   A. Karcher:
            "Semantic Models in Effects Based Operations"

14:20 - 15:15   E. Pinker:
            "An analysis of short-term responses to threats of terrorism"

15:15 - 15:35   J. Goldstein:
            "Terror attacks influence driving behaviour in Israel"

15:35 - 15:55   Coffee Break

15:55 - 16:40   P. Waldmann:
            "Terrorism as a symbolic strategy"

16:40 - 17:00   Z. Minchev:
            "Management of Network Resource Systems with Application to
                Critical Infrastructure Assessment"

17:00 - 17:20   T. Tsachev:
            "A dynamic evacuation model"

Titles and Abstracts
(In Order of Appearance)

Carlos Castillo-Chavez

"Epidemiological Approaches and Public Security"

In this presentation I will use a "contagion/contact" perspective to illustrate the challenges posed to mathematics from efforts to anticipate, prevent and control acts of terror. Examples will be provided from various contexts. The focus will be on specific questions: (1) What are the differences between natural epidemics and deliberate releases of biological agents? (2) What is the role of transient populations and response delays on the consequences and control of the deliberate release of biological agents in mass transportation systems? (3) What are the differences between epidemics and the spread of behaviors, ideas or rumors? and (4) What are the forces behind the establishment of resilient communities of fanatics?

Edward H. Kaplan

"Modeling Suicide Bombing and Related Terrorism"

Suicide bombings remain a favored tactic employed by terrorists operating in the Middle East and elsewhere. Countertactics range from social interventions to delegitimize the use of suicide bombings (e.g. the issuance of Fatwas), to intelligence-driven operations meant to interdict suicide bombers before they strike, to targeted killings of "ticking bombs" upon learning of an imminent threat, to last-minute attempts to detect suicide bombers via sensors at potential targets. I will report progress in modeling some of the issues outlined above while suggesting further questions in need of resolution.

Jonathan P. Caulkins, Gustav Feichtinger, <u>Dieter Grass</u>, and Gernot Tragler

"Is it important to manage public opinion while fighting terrorism?
An optimal control approach"

This talk presents a control model which studies optimal spending for the fight against terrorism. It is assumed that economic damages are larger the greater the number of terrorists and that the success of counter terror operations depends on public opinion. With these assumptions it is demonstrated that the long run outcome may crucially depend on initial conditions. In particular, it is demonstrated that a threshold may exist which separates the basins of attraction of optimal paths. The occurrence of a triple DNS point is proven numerically.

Doris Behrens, Jonathan P. Caulkins, Gustav Feichtinger, and <u>Gernot Tragler</u>

"For Sand or Saud:
Modeling Strategic Interactions in Counter-Terror Operations"

International terrorism is by any measure a principal concern of policy makers and a complex issue. This talk develops a set of inter-related optimal dynamic control/dynamic game models in an effort to shed light on certain strategic issues concerning how best to prosecute the "war on terror". The issue of primary interest concerns the proper way to conceptualize the objectives of the competing parties and the implications of misspecification at that level for success or failure. To focus on these issues other aspects of the problem are greatly simplified. Notably, the state of the terror system is reduced to a single variable denoting the current strength of the terrorists.

Reinhard Neck, Gottfried Haber, and Warwick J. McKibbin

"Terrorism and Macroeconomic Policies in the US and Europe"

This paper examines possible effects of terror activities on the design of macroeconomic policies in the United States and the European Union. Starting from the results of Eckstein and Tsiddon (Journal of Monetary Economics 2004), we derive estimates of the effects of one-time terror attacks and of continued terrorism on the economies of the US and the EU. Both changes without and with successful defense measures by the respective governments are simulated. Our main interest is with the resulting consequences for fiscal and monetary policies on the global level. We assume the US Federal Reserve and the European Central Bank to follow intermediate targets of either monetary or inflation targeting. For fiscal policies in the US and in the Euro Area, we assume that governments either refrain from pursuing active stabilization policies or follow either non-cooperative or cooperative activist fiscal policies. We analyze global effects of different European institutional arrangements under varying assumptions about policy reactions of the US and vice versa. Different scenarios are simulated with the macroeconomic McKibbin-Sachs Model (MSG Model), and the resulting welfare orderings are determined. They show how the advantages and disadvantages of different policy arrangements depend on the nature and scope of the terror activities the economies are faced with and on the assumptions made about defense and security policy reactions in the US and in Europe.

Andreas Karcher, T. Lehmann, and S. Pickl

"Semantic Models in Effects Based Operations"

After the Warsaw Pact broke down western military forces face new threats such as international terrorism, proliferation or asymmetric warfare. Therefore planning of operative and strategic missions is about to be shifted from an attrition-based towards an effects-based paradigm. This change opens up a broader and more far-seeing perspective to involved actors, since it strongly focuses on dependencies between actions taken and effects scored in consideration of objectives given. By emphasising the network nature of effects complexity grows beyond human manageability. To support a planner in coping with large amount of more or less structured information classical technologies for integration of heterogeneous data quickly reach their limits. This presentation shall give a brief overview on how latest Semantic Web Technologies enable modelling of complex structures and allow different classes of reasoning to entail existing knowledge – each of them providing different semantics but all depending on each another within the common planning process.

Edieal Pinker

"An analysis of short-term responses to threats of terrorism"

Two important defensive mechanisms available to governments combating terrorism are warnings and the deployment of physical resources. Warnings are relatively inexpensive to issue but their effectiveness suffers from false alarms. Physical deployments of trained security personnel can directly thwart attacks but are expensive and need to be targeted to specific locations. In this paper we model the joint optimization of defenses against terrorist attacks based on warnings and physical deployments when there is uncertainty in the timing and location of attacks. We model both private warnings issued to security forces and public warnings broadcast to the general public. By structuring the tradeoffs faced by decision makers in a formal way we shed light on an important public policy problem. We show that the interaction between the use of warnings and physical defenses is complex and significant. For public warnings we also model the possible response of terrorists and show how these responses influence the effectiveness of such warnings.

Joshua R. Goldstein

"Terror attacks influence driving behaviour in Israel"

Terror attacks in Israel produce a temporary lull in light accidents followed by a 35% spike in fatal accidents on Israeli roads 3 days after the attack. Our results are based on time-series analysis of Israeli traffic flows, accidents, and terror attacks from January 2001 through June 2002. Whereas prior studies have focused on subjective reports of posttraumatic stress, our study shows a population-level behavioural response to violent terror attacks.

Peter Waldmann

"Terrorism as a symbolic strategy"

My principal thesis is that terrorism is not a case of instrumental but of symbolic violence, of violence as a means of communication. Terrorism can be considered as an extreme form of what in our days is often described as asymmetrical warfare. Terrorist groups are quite weak. Generally they lack the necessary resources (in terms of personal, weapons etc.) to attack their enemy openly and directly. That is the main reason why they go underground and use violence as a kind of signal or "message". That means at the same time that terrorism is an indirect strategy. When violence is employed in a direct, instrumental way, generally there are only two conflict parties, confronting one another and fighting against one another. Compared with that, in cases of symbolic violence three parties or groups are involved: Those who employ violence (the terrorists), the victims who suffer from the violent act, and the broad public which is the real target group of the terrorist act or "message". Terrorist messages will rise the more attention, the more surprising and cruel they are and the more they constitute a contrast to every day life. An explosion in Bogota or Bombay where violent conflicts are something very usual will not meet with the same interest by the media and the broad public as a bomb which is exploding for instance in Stockholm or Vienna. For this reason terrorists prefer as a stage for their spectacular attacks the democratic societies of the west. Within the broad public which is intended to listen to the terrorists' message we can rougly distinguish two groups: The terrorists' enemies whom they want to frighten and to provoke to an overreaction on one side, and the terrorists' supposed sympathisers whom they wish to encourage and win over for their project on the other. Summing up the idea exposed here I would define terrorism as a strategy which consists in shocking attacks against a political order from the underground. These attacks pursue the aim of spreading fear and insecurity among the enemies of the terrorists, but at the same time to produce sympathy and the will to support the terrorists among their supposed friends.

Emil Kelevedjiev & <u>Zlatogor Minchev</u>

"Management of Network Resource Systems with Application to Critical Infrastructure Assessment"

A theoretical model and an experimental computer interactive implementation are proposed for predicting critical behaviors of a large networks flow system. A possible application is management of the critical infrastructure in a water supplying system or an electricity power submission network. A model is based on linear programming approach to find solutions in multi-stage in time multi-criteria optimization of the involved graph flow problem. Due to the ability of interactive re-computing with different sets of input and control data, an expert using the proposed implementation can perform the adequate decision making.

<u>Tsvetomir Tsachev</u>

"A dynamic evacuation model"

The presentation considers a mathematical model of evacuation problems arising in situations like the following one: A hazardous phenomenon (flood waters, poisonous cloud, etc.) is approaching a populated area in a predicted manner - the area covered by the phenomenon is assumed known (at given moments of time in the discrete time case and in a whole time interval in the continuous time case). The aim is to evacuate the population from the area of the disaster to safe locations outside this area, given the various constraints - the roads' capacities, the time periods in which each of the roads will be usable, the avilability of support vehicles, the accommodation capacities at each of the safe locations.

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