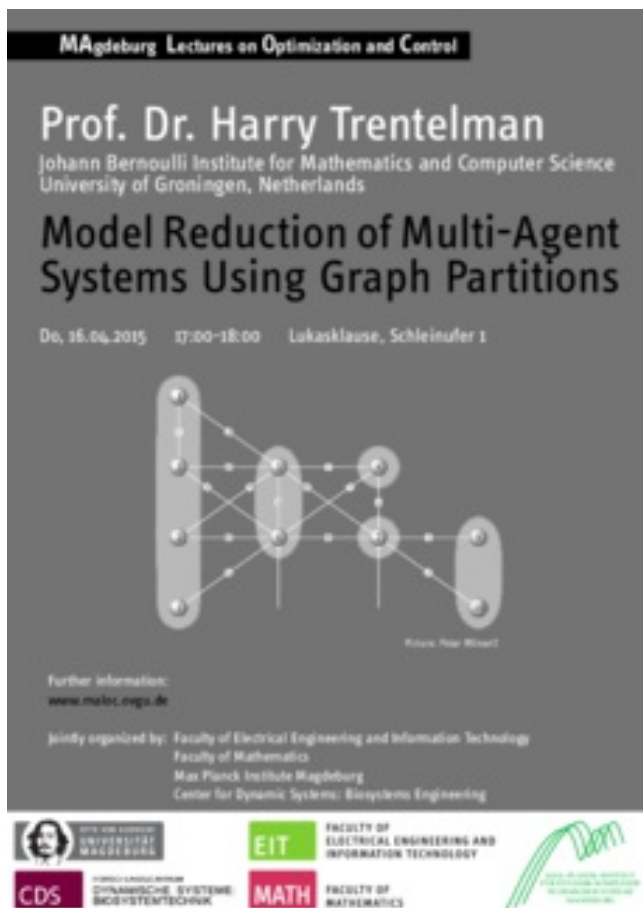


## MAGDEBURG LECTURES ON OPTIMIZATION AND CONTROL

**Harry L. Trentelman**



MAGdeburg Lectures on Optimization and Control

Prof. Dr. Harry Trentelman  
Johann Bernoulli Institute for Mathematics and Computer Science  
University of Groningen, Netherlands

Model Reduction of Multi-Agent  
Systems Using Graph Partitions

Do, 16.04.2015 17:00-18:00 Lukasklausur, Schleiner 1

Further information:  
[www.maloc.orgu.de](http://www.maloc.orgu.de)

Jointly organized by: Faculty of Electrical Engineering and Information Technology  
Faculty of Mathematics  
Max Planck Institute Magdeburg  
Center for Dynamic Systems: Biosystems Engineering

CDS EIT MATH

### Model Reduction of Multi-Agent Systems Using Graph Partitions

› Prof. Dr. Harry L. Trentelman  
(<http://www.math.rug.nl/~trentelman/>)

Johann Bernoulli Institute for Mathematics and  
Computer Science  
University of Groningen  
The Netherlands

#### Time & Place

The presentation on April 16, 2015 will be given  
in the Lukasklausur › (Schleiner 1, 39104  
Magdeburg) (<http://ifatwww.et.uni->

[magdeburg.de/syst/maloc/seminars/Standort%20Lukas%20Klausur.pdf](http://magdeburg.de/syst/maloc/seminars/Standort%20Lukas%20Klausur.pdf)) and starts at 5.00 p.m.

#### Abstract

This talk deals with the problem of model reduction of multi-agent systems defined on a graph. Reduced order models are obtained by clustering the vertices (agents) of the underlying communication graph by means of suitable graph partitions. In the reduction process the spatial structure of the network is preserved and the reduced order models can again be realized as multi-agent systems defined on a graph. The agents are assumed to have single-integrator dynamics and the communication graph of the original system is weighted and undirected. The proposed model reduction technique reduces the number of vertices of the graph (which is equal to the dynamic order of the original multi-agent system) and yields a reduced order multi-agent system defined on a new graph with a reduced number of vertices. This new graph is a weighted symmetric directed graph. It is shown that if the original multi-agent system reaches consensus, then so does the reduced order model. For the special case that the clusters are chosen using an almost equitable partition of the graph, we obtain an explicit formula for the H-2 norm of the error system obtained by comparing the input-output behaviors of the original model and the reduced order model. We also prove that the error obtained by taking an arbitrary partition of the graph is bounded from below by the error obtained by using the largest almost equitable partition finer than the given partition. Finally, we

extend our results on single integrator dynamics to the case that the agent dynamics is an arbitrary linear input-output system.

### **Short CV**

Harry Trentelman is a full professor in Systems and Control at the Johann Bernoulli Institute for Mathematics and Computer Science of the University of Groningen. From 1985 to 1991 he served as an assistant professor, and as an associate professor at the Mathematics Department of the University of Technology at Eindhoven, the Netherlands. He obtained his PhD degree in Mathematics from the University of Groningen in 1985. He serves as a senior editor of the IEEE Transactions on Automatic Control and as an associate editor of Automatica. He is past associate editor of the SIAM Journal on Control and Optimization and Systems and Control Letters. Dr. Trentelman is a Fellow of the IEEE.