

# Report on my stay as a Leibniz fellow at MFO

## October 15, 2008 - February 13, 2009

Laurentiu Leuştean

March 5, 2009

I was a Leibniz Fellow at MFO with the project “Proof mining in ergodic theory and metric fixed point theory” during the period October 15, 2008 - February 13, 2009, with a Christmas break between December 20, 2008 and January 4, 2009.

I visited MFO twice before, in 2005 and 2008, when I took part in the workshop “Mathematical Logic: Proof Theory, Constructive Mathematics”, and I liked it very much. My main motivation to apply for a Leibniz fellowship was that at MFO I could fully concentrate, I could do mathematics from morning until night without thinking at anything else.

I want to emphasize that my stay at MFO was by far the best time in my whole scientific life. From the scientific point of view, being at MFO is like being in paradise; this is also the opinion expressed by my collaborators after one week spent at the institute. I think that this fellowship was a unique chance for me, I am very happy that I got it and I would like very much to come back at MFO in the future. At the end of my stay, I was happy that I go back home at my family, but in the same time I was sad that I leave the institute and that this extraordinary period finished.

As another MFO fellow, Stefan Maubach, emphasized in his personal report, meeting around 40 mathematicians every week, hearing so many stories, so many different impressions, going to talks in totally different areas of mathematics, was a unique experience.

I received many times from the researchers participating at the workshops the question whether I was not too lonely, some said that after more than one month at the institute there is the danger to become ”crazy”. Since I drove to Oberwolfach and Darmstadt is not so far, I could drive home from time to time, so this was not an issue for me. Anyway, there were Leibniz fellows who spent their whole period at MFO and they did not have the problem of being lonely. The reason is that we were so convinced that this

is a unique time, so that we fully concentrated on doing mathematics, we did not have time to feel lonely.

I think that the library of the institute is one of the best in the world. It is a very nice sensation when you read mathematics and you need a book or some paper to be almost sure that it is there and in one minute you can have it on your desk. I worked during my stay at MFO on my laptop, in the down hall from the journal room. Everything worked very well.

The people from the administration staff were extremely nice, always being ready to help when I had any problem.

During my stay at MFO, I have written a long survey on recent applications of proof mining to the fixed point theory of (asymptotically) non-expansive mappings and to the metastability (in the sense of Terence Tao) of ergodic averages in uniformly convex Banach spaces. Besides presenting these applications in a uniform manner, this survey had also new results.

By *proof mining* we mean the logical analysis (using proof-theoretic techniques) of mathematical proofs with the aim of extracting new numerically relevant information hidden in the proofs.

The stay at MFO allowed me to start a collaboration with Professors Genaro López Acedo and Rafael Espínola from the University of Seville, who visited me in the week January 17 - 24, 2009. We had many discussions on potential applications of proof mining in functional analysis and we started a project on uniformly convex hyperbolic spaces in fixed point theory and geodesic geometry. Together with Genaro and a PhD student of him we have begun to write a paper on Halpern-type iterations in normed spaces and Hadamard manifolds, where, between others, we compute rates of so-called "asymptotic regularity" using proof mining methods.

My stay at MFO was also the ideal time to introduce myself in other areas with a great potential for applying proof mining methods as ergodic Ramsey theory, metric geometry or hyperbolic groups and their algorithmic properties, and to learn mathematics in general.

## 1 The publications planned or written during my stay

1. Proof Mining in Metric Fixed Point Theory and Ergodic Theory, OWP 2009 - 05, 71 p.
2. Alternative iterative methods for nonexpansive mappings (together with Genaro López Acedo and Victoria Martín-Márquez), in prepara-

tion.

3. Uniformly convex hyperbolic spaces in fixed point theory and geodesic geometry (together with Genaro López Acedo and Rafael Espínola), in preparation.

Dr. Laurențiu Leuştean

Department of Mathematics, Technische Universität Darmstadt  
Schlossgartenstrasse 7, 64289 Darmstadt, Germany

and

Institute of Mathematics "Simion Stoilow" of the Romanian Academy,  
Calea Griviței 21, P.O. Box 1-462, Bucharest, Romania

E-mail: leustean@mathematik.tu-darmstadt.de

Web page: <http://www.mathematik.tu-darmstadt.de/~leustean>