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About MI Lecture Note Series

The Math-for-Industry (MI) Lecture Note Series is the successor to the COE Lecture Notes, which were published for the 21st COE Program "Development of Dynamic Mathematics with High Functionality," sponsored by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) from 2003 to 2007. The MI Lecture Note Series has published the notes of lectures organized under the following two programs: "Training Program for Ph.D. and New Master's Degree in Mathematics as Required by Industry," adopted as a Support Program for Improving Graduate School Education by MEXT from 2007 to 2009; and "Education-and-Research Hub for Mathematics-for-Industry," adopted as a Global COE Program by MEXT from 2008 to 2012.

In accordance with the establishment of the Institute of Mathematics for Industry (IMI) in April 2011 and the authorization of IMI's Joint Research Center for Advanced and Fundamental Mathematics-for-Industry as a MEXT Joint Usage / Research Center in April 2013, hereafter the MI Lecture Notes Series will publish lecture notes and proceedings by worldwide researchers of MI to contribute to the development of MI.

October 2014
Yasuhide Fukumoto
Director
Institute of Mathematics for Industry

Workshop on "β-transformation and related topics"

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Preface

The present volume of Math-for-Industry Lecture Note Series collects the abstracts of all invited talks at the workshop on "β-transformation and related topics" held at Institute of Mathematics for Industry (IMI), Ito-Campus, Kyushu University, Fukuoka, Japan, March 10, 2015. The workshop is held during the visit to IMI of Professor Evgeny Verbitskiy (Leiden and Groningen) and Professor Charlene Kalle (Leiden). Professor Verbitskiy is now a visiting professor at IMI.

The purpose of this workshop is to overview recent developments around β-transformations and also to provide a forum for discussions of related topics and for exchange of ideas and information between researchers who investigate them from various points of view.

A β-transformation is a piecewise linear expanding map $T_\beta : [0,1) \to [0,1)$ ($\beta > 1$) defined by $T_\beta(x) = \beta x - \lfloor \beta x \rfloor$. This transformation is closely related to the so-called β-expansions of real numbers which generalize the q-adic expansions of real numbers for integer q. The study on this transformation was initiated by Alfréd Rényi (1957). He showed that T_β has the unique absolutely continuous invariant probability measure ν_β, under which T_β is ergodic. William Parry (1960) gave sufficient conditions for a sequence of integers from a finite alphabet set $\{0, 1, \ldots, \lceil \beta - 1 \rceil\}$ to arise as a sequence of digits of a β-expansion, which naturally induces shift dynamical systems. He also gave an expression of the Radon-Nikodym density of ν_β. Yoichiro Takahashi (1973) and Yoichiro Takahashi and Shunji Ito (1974) studied further the symbolic dynamical structure of β-transformations. Since the transformation was introduced, over many years, there have been lots of research from various viewpoints. It still continues to be developed.

Workshop talks cover several topics related to β-transformations from both theoretical and practical points of view. C. Kalle speaks about recent results on isomorphisms between positive and negative β-transformations. S. Akiyama introduces and discusses a natural generalization of T_β which are extended to transformations on the complex plane by adding rotations. T. Kohda and Y. Jitsumatsu make emphasis on the practical aspect of β-transformations. T. Kohda gives a brief review on the background of A/D(analog-to-digital) and D/A(digital-to-analog) conversion, and discusses the advantages of β-encoders proposed by him and co-authors. Y. Jitsumatsu discusses a random binary sequence generator based on the output sequence from the β-encoder. R. Tanaka considers a Dirichlet series associated with

independent 0-1 random coefficients and discuss the regularity of its distribution. H. Sumi discusses fractal structure of rational semigroups and complex version of devil's staircase and Takagi's function in the framework of multifractal formalism. E. Verbitskiy speaks about random β- and continued fraction transformations and discusses existence of invariant measures and their regularity.

We are very much grateful to all the participants, especially the invited speakers for their contribution to preparing abstracts and giving talks. We are also grateful to Ms. Tsubura Imabayashi for her help. Without her generous effort, the workshop would not have been so smoothly organized.

We hope all the participants enjoy this workshop and have a pleasant stay in Fukuoka.

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March 2015

Organizer: Tomoyuki Shirai
(IMI, Kyushu University)