独立行政法人日本学術振興会理事長 殿 To: President, Japan Society for the Promotion of Science

研究活動報告書

Research Report

1.受入研究者/ Host researcher	
受入研究機関・部局・職 Name of Host Institution, Department and Title	京都大学・数理解析研究所・准教授
受入研究者氏名 Host Researcher's Name	CROYDON David Alexander
2. 外国人招へい研究者/Fellow	
所属研究機関・部局・職 Name of Institution, Department and Title	The Hebrew University of Jerusalem · Einstein Institute of Mathematics · 准教授
外国人招へい研究者氏名 Fellow's Name	FELDHEIM Ohad Noy
3. 採用期間/ Fellowship Period	
2024 年 4 月 2 日	~ 2024 年 10 月 13 日
4. 研究課題/ Research Theme	
グラフ的負荷分散と確率熱方程式の関係	

5. 研究活動報告/Research Report

(1) 研究活動の概要・成果/Summary of Research Results

The topic of the proposal was the link between graphical load balancing and the stochastic heat equation. Concerning a version of the discrete model itself, we discussed a strategy for deriving the correct scaling on a one-dimensional torus involving moment estimates. We conjecture that checking these will be possible by extending the ideas of Alistarh/Nadiradze/Sabour, but this remains a project for the future.

As noted in the proposal, the discrete load-balancing model is conjectured to have links with Gaussian fields on graphs. In view of understanding scaling limits, we discussed how versions of such processes behave on fractal-like spaces (see Baudoin/Chen and Hambly/Yang for related work). In particular, the main aspect of the project we ended up focusing on was how fractional Gaussian processes are affected by the underlying geometry of the space upon which they are built. In particular, we are close to completing a result on the dimension of the zero set of fractional Gaussian fields on spaces equipped with resistance forms, which includes the Sierpinski gasket as a central example. We anticipate the tools we developed will also be useful for understanding the scaling limits of discrete processes that converge to these. During his visit, regular discussions were held between the host and fellow at RIMS, during which they exchanged knowledge of fractals and Gaussian processes. Taking part in some of these interactions were Naotaka Kajino (Kyoto University) and Naomi Feldheim (Bar Ilan University). Ohad Feldheim also undertook the following activities:

- Attended *NYU Shanghai-Kyoto-Waseda Young Probabilists' Meeting* (8-9 May 2024), discussing with researchers from the universities mentioned in the meeting title and beyond.
- Presented his work at *Random Fields and Processes on Graphs and Fractals* (10-12 June 2024), which gave a chance for him to interact with many domestic probability researchers.
- Jointly with Naomi Feldheim, gave a lecture series at RIMS entitled *Gaussian stationary processes and their level crossings (May/June 2024)*, which was attended by Kyoto University faculty and graduate students, as well as some online participants from other institutions.



• Gave a talk at the *Tokyo Probability Seminar* during an academic visit to Waseda University, where he was hosted by Takashi Kumagai (see photo), discussing Gaussian fields.

In addition, several hours of extensive discussions took place between the fellow, Naomi Feldheim and Okada Izumi from Chiba University, during her visits to RIMS, especially concerning entropic repulsion phenomena in stationary Gaussian processes.

As for the future, the plan is to complete the aforementioned work on the zero set of fractional Gaussian fields on fractal spaces, and then to continue discussions by studying the relation between the continuous model and approximating discrete ones, both stationary and dynamic.

The Fellow would like to express his gratitude to JSPS, to the host and to RIMS for their superb hospitality. The administrative staff of the institute was very kind and helpful, and both arrival and departure procedures were conducted efficiently and pleasantly. His stay in Japan was most educational, fruitful and pleasing, and he is looking forward to conducting further academic visits to Japan and to RIMS in particular.

(2) 主な研究発表(雑誌論文、学会、集会、知的財産権等)/Main Research Publications

During the Fellowship, the fellow oversaw the completion of the following work:

• "Expected Number of Level Crossings of a Stochastic Gaussian Process: A Short Conceptual Proof for Kac-Rice Formula", M.A. thesis, Asa Front.

This project, which related to the lecture series the fellow gave in RIMS is planned to result in a joint paper between the host and his student, which will acknowledge the JSPS grant and RIMS.

We also anticipate there will be further articles forthcoming based on the collaboration between the host and fellow.

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(3) その他/Remarks
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A planned visit to Professor Shirai Tomoyuki from Kyushu University, and participation in the German-Japanese Conference in Hokkaido were canceled due to personal reasons, namely, an unforeseeable serious medical situation with the fellow's son. Hopefully, an opportunity to visit Prof. Shirai will present itself in the future.