年　　月　　日

工学系学生国際交流基金報告書

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所属専攻・研究室・学年：電子物理工学専攻　松澤・岡田研究室　博士3年	
派遣先大学・専攻：University College Dublin, School of Electrical, Electronic and Communications Engineering 受入教員名：Prof. Robert Bogdan Staszewski	
派遣期間：平成　27　年　3　月　3　日　～　平成　27　年　5　月　28　日	
申請カテゴリー： □(C1)SERP　□(C2)AOTULE　□(C3-a)部局間協定校　□(C3-b)全学協定校　■(C4)その他	
研究（プロジェクト）題目： Low-power Low-phase-noise All-Digital Phase-locked loop	

- 帰国後1か月以内に工学系国際連携室宛（ko.intl@jim.titech.ac.jp）にMS Wordファイルにて提出ください。
- SERPで派遣された場合は、受入教員の評価書も添付して下さい。
- この表紙を含まず、ページ数は2～4ページ、ファイルサイズは3MB以内としてください。
- 研究室や宿舎内の様子の写真、図表、イラスト、滞在中のその他の写真などは挿入可です。ただし、それらを掲載する際には簡単な説明を加えて下さい。
- 提出された報告書の2ページ目以降を工学系のホームページに掲載いたします。また、別途、クロニクルへの執筆をお願いすることがあります。

報告書必須記載事項
- 派遣大学の概要（所在地、創立、大学の規模など）
- 所属研究室での研究概要とその経過や成果、課題など
- 所属研究室内外の活動・体験（日常生活・余暇に行った事など）
- 留学先での住居（寮、ホームステイ等)、申し込み方法、ルームメイトなど
- 今回の留学から得られたもの、後輩へのメッセージ、感想、意見、要望

東京工業大学大学院理工学研究科

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所属専攻　：　Physical Electronics

派遣先　：　University College Dublin

（次ページ以降に記入してください。）

Teerachot Siriburanon
Matsuzawa and Okada Laboratory
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Internship Report

My host university for a 3-month internship was the University College Dublin (UCD) Founded in 1854, it is one of the most famous university in Ireland which occupy a spacious area and numerous number of academic departments. There are two campuses located in Belfield and Smithfield. The campus which hosted my internship was in the department of Electrical, Electronic and Communications Engineering which is 20 minutes from Dublin city center by bus. There are more than 32,000 student in which 16,000 are undergraduates and 8000 are post-graduates students.

My mentor was Professor Robert Bogdan Staszewski which is a famous inventor of an all-digital phase locked loop that was first developed in Texus Instrument, USA. Later, he became a professor at TU Delft in Netherlands and recently moved to UCD in Ireland. The outline of my research engaged during the internship period is as followed. The design of an all-digital phase locked loop requires a high resolution digital phase detection for low in-band phase noise which is required for high-precision clock. The conventional digital phase detector using a time-to-digital converter based on an inverter chain requires high power consumption for high resolution and large dynamic range. The study during this internship period will try to investigate a solution to achieve a high resolution in digital phase detection of an all-digital phase locked-loop while consuming low power consumption. As a result, it is capable of achieving sub inverter delay level while consuming reasonable power consumption. In a later stage, it is found that the implementation of the digital block after the TDC cannot be modified. Therefore, the implementation on the TDC side has to be updated. In order to deliver the same 12-bit thermometer codes to the digital top block, a delta-sigma modulator is implemented in order to dither 6-bit information into 1-bit information that adds to the output of the first-stage TDC. Therefore, the updated TDC can deliver 12-bit thermometer codes to the digital loop filter and control the DCO.

The research life style in Ireland is similar to Japan, where each student is assigned to a particular lab with his/her own interested mentor. The meeting and progress report styles are differed by the preference of their mentor. Apart from the research activity in the lab, I have a chance to join seminar organized by cadence the integrated circuit design tools. I have attended a lecture related to the future internet of the things (IoTs) and field trip to a leading semiconductor company, *i.e.*, Intel. These activities gives me opportunities to widen my knowledge in the field of electronic circuit designs and a chance to

meet professors and engineers in the same field. Moreover, in terms of leisure, Ireland offers a number of attractions and nature to be explored. It also offers a rich culture in food and music that can be found in the city centre.

Going for an internship under a period of three month in Ireland for a foreign nationalities that would require a visa, it is required to have an evidence of address from the host family or contract of apartment. Therefore, it is advice to cooperate this closely with a coordinator from the school that is responsible for. In my particular case, I have been assisted by the school office to find a host family. The price of accommodation should also be discussed closely with an owner to meet and satisfy the requirements of both parties. Sometimes the accommodation fee does not include utilities and internet fee. Therefore, this matter should be discussed before completing a deal with the owner.

During the internship in Ireland, I have not only receive and broaden my knowledge in the field of research. I have also explored the nature, culture and food from the other part of the world. Moreover, this chance may give a possibility for you for a future career. I would recommend anyone who is interested to join this program and try to make a full use of it. Please choose the school and country of interest that suits your study that future career. I also strongly believe that you will additionally gain experience and enjoy new culture and people.

Fig.1 Castle during trip to Intel.