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Engineering doctoral study in Irish Universities: A personal perspective

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Abstract

Research is increasingly becoming an international endeavour, which are driven through international communication and collaboration. It is therefore necessary to become aware of different national experiences so as to provide a unified international approach. This is particularly true for PhD study. In this regard, this paper outlines engineering doctoral studies in an Irish University. A general outline of the entry requirements is provided, along with requirements during the PhD studies. The personal experience of the author is provided. Finally, a brief overview of the PhD research conducted by the author during his PhD is provided.

Ključne riječi: PhD studies, research, engineering, energy harvesting

Tehnički doktorski studij na irskim sveučilištima: osobno viđenje

Sažetak

Istraživački rad sve češće dobiva obilježje međunarodne aktivnosti, što se potiče kroz rastuću komunikaciju i suradnju na međunarodnoj razini. Zato se trebamo upoznavati s iskustvima u raznim državama kako bi se iz njih mogao izvesti objedinjeni međunarodni pristup. To naročito vrijedi za doktorske studije. S tim u vezi, u ovom se radu ukratko opisuju tehnički doktorski studiji na irskom sveučilištu. Daje se opći prikaz uvjeta za pohađanje studija, isto kao i zahtjevi koji se trebaju ispuniti u toku trajanja studija. Iskazano je i osobno iskustvo autora rada. Na kraju se daje kratak prikaz doktorskih istraživanja koje je autor proveo u toku svog dokorskog studija.

Keywords: doktorski studiji, istraživanje, inženjerstvo, žetva energije

1 Introduction

For entry into a PhD degree programme for engineering within Ireland, students must hold, at a minimum, an accredited undergraduate bachelor's degree relevant to the proposed programme or a Masters degree. The minimum standards that are required from the undergraduate degree for the student to become eligible for admission to the PhD programme is set down by the University, with a common requirement of a minimum grade of Second Class Honours, Grade I being necessary. There are two possible research programmes formats that can be undertaken to pursue a PhD degree in engineering. The first is the Traditional PhD programme, whereby students embark on a minimum of three years of study before they can obtain their PhD. This programme does not require students to complete taught modules as part of their studies, which are optional and it is at the discretion of the students as to whether they choose to undertake such coursework. The second type of programme is the Structured PhD programme. Under this programme, students are required to undertake coursework as part of their studies, with a four-year period of study required before becoming eligible to defend your doctoral thesis.

The two PhD programmes also have different requirements pertaining to supervision. While both require that doctoral study students have a primary supervisor, the Structured PhD programme requires that co-supervisor also be present as part of the mentoring and supervision team. As part of the Traditional PhD programme, co-supervision is allowed but not mandatory.

1.1 Formal assessment of students research output

As part of both PhD programmes of study, students are required to complete an Annual Review at the end of each year of study in order to progress to the following year of study. This review consists of a Panel of Assessors, which consists of an internal evaluator, drawn from the academic faculty within their respective department and an external evaluator, drawn from the academic faculty outside of their department but within the School. For example, a PhD student in the Department of Civil Engineering would be assessed by an internal academic from the Department and an external academic from within the School of Engineering, but from the Department of Electrical Engineering or similar. The Annual Review takes the form of a presentation given by the student, whereby the student presents research conducted in the preceding year, their ongoing research, a detailed plan for the coming year of research and a plan on the focus of their research until the completion of their studies. Following the presentation, the student will be interviewed by the Panel on their presentation and, if deemed satisfactory, will be recommended to continue their studies through advancement into the subsequent year of their programme.

1.2 Duties and responsibilities of PhD students

Within Engineering PhD programmes in Ireland, PhD students may be required to contribute a number of hours to the Department or School within which they are conducting their studies. Within the School of Engineering in University College Cork (UCC), this contribution takes the form of 100 hours per annum to be completed by the student to contribute to the School. A wide range of activities are considered under this contribution, such as providing tutorials or labs to undergraduate students and outreach, such as representing the School at University Open Days, amongst a host of others. Apart from this contribution, all other time is allocated to the research activities of the student, with students not obliged to provide any other teaching aside from this contribution of time.

1.3 Funding opportunities

Within Ireland, there are many funding options which students can apply for to fund their PhD studies. Oftentimes, supervisors have funding through which to support their students. In Ireland, large scale funding is provided nationally in science and engineering through Science Foundation Ireland (SFI), a state-funded funding agency and internationally, through European funded bodies, under programmes such as Horizon 2020. Individual funding is also available, with the state run Irish Research Council providing funding for individual students through the Government of Ireland Postgraduate Scholarship Scheme, which covers tuition fees, a small expense budget for the student and a living stipend for between one and four years, depending on the stage of study the recipient is at.

1.4 Awarding of PhD degree

Upon the completion of the both the Traditional and Structured PhD programmes, students undergo an oral defence of their doctoral thesis, the PhD Viva, in order to be awarded their PhD degree. An examination panel is formed for each Viva, consisting of an internal and external assessor. The internal assessor is drawn from the academic faculty of the Department or School and an expert in the field of the students' research drawn from an external university. As part of the Viva process, there may be an option for the student to first provide a presentation to the examination board as a means of providing an overview of the completed research before completing an oral examination. Each Department within the University has regulations relating to this presentation, with it being either mandatory to provide such a presentation or at the students' discretion. Following the Viva examination, there are six possible results, namely:

1. Award – As is, with no corrections to the thesis required.
2. Award – Minor corrections to the thesis required.
3. Award – Major corrections to the thesis required for the PhD is awarded.
4. Reject – With permission to submit a significantly revised thesis to be considered in a second oral defence.
5. Reject – With the awarding of a Masters Degree in place of a Doctoral Degree.
6. Reject – No degree is awarded.

2 Personal experiences during an engineering PhD programme

In 2011, I obtained a Bachelor of Engineering Degree (Honours) from the Department of Civil and Environmental Engineering, UCC. As part of this degree, students are required to undertake a Final Year Project through research and it was this module where I was first introduced to research. The topic of the project was an investigation into the placing of concrete onto precast arch structures which are employed nowadays when constructing arch bridges. The central research question was to determine the effects that lateral pressure, exerted by concrete before hardening, can have on the precast structures [1]. Following this, I chose to remain in UCC and pursue further research opportunities, in the form of a Masters Degree by research. My primary supervisor for this Degree was Dr Vikram Pakrashi, Lecturer in Structural Engineering within UCC, who had also previously been my supervisor for the Final Year Project and had introduced me to research, along with Dr Alan Mathewson, of Tyndall National Institute, who was my co-supervisor.

The Masters Degree was intended to be a one year programme, conducted solely through research and commencing in October 2011. After six months of study, I had made the decision to pursue a PhD and therefore applied to transfer to a Traditional PhD programme. The result of my application was that, in lieu of an Annual Review at the end of this year of study, I completed a Transfer to PhD Assessment. The format of this assessment was in keeping with the Annual Review and the recommendation from the Panel was for my transfer to a PhD programme. This resulted in my original year being regarded as Year 1 of my PhD and not, as was originally intended, as the 12-month Masters Degree. Following from this Year 1, I continued in my PhD programme and completed two Annual Reviews, at the end of my second and third years of study, before completing my Thesis Defence at the end of Year 4 in 2015. I found these Annual Reviews to be beneficial to my research as it provided a forum for critical assessment of my completed and proposed research from accomplished researchers who were not intimately associated with my work. These occasions enabled me to refine not only my communications skills, but also the direction and substance of my research work.

The funding of my PhD studies came from three different sources. For the second year of my PhD, I applied for and was awarded The John Sisk Postgraduate Research Scho-

larship in Civil Engineering 2012/ 2013, a funding scheme which is managed by the School of Engineering in UCC. For my third year, I was awarded a Scholarship under the Irish Research Council Government of Ireland Postgraduate Scholarship Scheme 2013/2014 and for my fourth and final year, I received funding through a research project of my co-supervisor, award to him from SFI. All three awards covered my tuition fees, provided me with a small expense budget and a stipend.

At the end of my studies, I underwent my PhD Viva in December 2015, one month following the submission of written thesis. As my assessment board, I had an internal assessor from the School of Engineering, Dr. Denis Kelliher, a lecturer in Structural Engineering, and as external Prof Giuseppe Marano, from the Technical University of Bari, Italy. As part of the process, I chose to provide a short presentation, of 15 minutes in duration, to the board. The aim of the presentation was to provide them with my insight verbally into the central research topic of my thesis, the reasons for the structure and provide general overviews on my work. Following the oral interview, I was awarded my PhD with minor corrections required to the written thesis. I submitted these corrections in a final, amended written thesis in January 2016, and finally graduated in June 2016.

3 Overview of PhD research

The central research question that I addressed in my PhD thesis was the feasibility of using energy harvesting technology integrated with civil infrastructure systems and associated applications. Vibration based energy harvesting technology utilises the dynamic response of the host structure to which it has been applied as the base excitation for the conversion of kinetic energy into electrical energy [2]. Therefore, through the integration of such technology with a structure, the generated voltage output from the harvester will contain signatures of both the harvester and the structure and can be utilised for applications ranging from energy harvesting, structural health monitoring (SHM) [3] and as indicators for control. The overarching goal of investigating and combining these three applications formed my research topic, as illustrated in Figure 1.

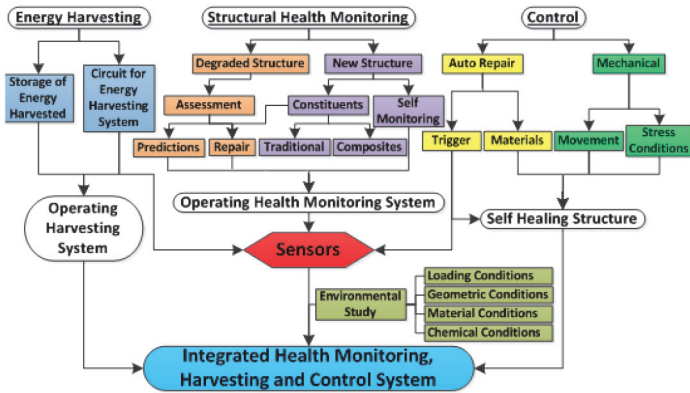


Figure 1. Research goals and objectives for PhD research studies.

To prove the applications that can arise from energy harvesting technology integration with civil infrastructure, I adopted four major research themes. Firstly, I investigated theoretically applications that arise from train-bridge interaction, both in terms of the amount of energy which may be harvested and SHM applications that can arise from the deployment of such technology [4]. Secondly, I investigated the use of a laboratory procedure for the validation of energy harvesting devices using theoretical and measured acceleration datasets of civil infrastructure. Thirdly, through the use of scaled laboratory experiments, the physical interaction between the device and the infrastructure system can be validated [5] and finally, the full scale deployment of novel harvesting devices with a full scale bridge structure was successfully achieved. The laboratory experiments were completed within the experimental laboratory of the Dynamical Systems and Risk Laboratory (DSRL), which I assembled and ran during the course of my studies (Figure 2).



Figure 2. Experimental laboratory as part of the Dynamical Systems and Risk Laboratory (DSRL), UCC.

4 Research visits

Some of the most defining moments of my research during my PhD were due to research visits I undertook to different universities around the globe. I applied or accepted any opportunity to visit different research groups, so as to enhance my collaborations, knowledge, and exposure to different research approaches and philosophies. I visited the Indian Institute of Technology – Madras (IIT-Madras), India; Rice University, USA and KTH Royal Institute of Technology, Sweden. The visits I undertook were generally four weeks in duration and had a defined scope of research which would be undertaken during my stay. As a result, each of the three visits I undertook have resulted in a journal publication, either published or under review and I have established working collaborations with many groups which I would otherwise have not had the opportunity to work alongside.

5 Conclusions

This paper provides an overview of PhD studies in engineering from an Irish perspective. In this regard, a general outline of PhD formats and requirements within Ireland is outlined, including an overview on the general entry requirements, the responsibilities of the doctoral researcher, common funding opportunities and finally, the examination and awarding of the PhD Degree. The personal experiences of the author arising from his time as a PhD student in Ireland is provided, as is a brief overview of his research topic and work completed as part of his studies. Finally, research visits undertaken by the author during his PhD are outlined and the importance of such visits emphasised.

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