



National Roads Authority

Research Fellowship Programme

2010 Fellowships

National Roads Authority Research Fellowship Programme 2010 Fellowships

Background

Established under the Roads Act, 1993 the National Roads Authority (NRA) is a non-commercial semi-state agency with overall responsibility for the development and maintenance of the national road network.

Delivery of the national roads element of the National Development Plan 2007-2013 launched recently by Government represents a major element of the Authority's responsibility.

Research remit

The remit of the NRA encompasses training, research and testing as cited in Section 19 (1) (h) of the Roads Act, 1993, viz: "The Authority may in relation to national roads carry out, arrange to have carried out or assist the carrying out of training, research or testing activities in relation to any of its functions".

Research Fellowship Programme

The Board of the NRA is committed to a formal roads research and development programme. The primary objective of this programme is to contribute to cost efficiency, innovation and environmental sustainability in delivering the national road network. In achieving this objective, the programme will promote practical measures that will contribute to reducing costs, enhancing quality and/or encouraging innovation in regard to the Authority's functions in the planning, construction and maintenance of national road schemes. The measures will also have to take cognisance of the Authority's responsibility for the promotion of standards, having regard to efficiency, economy and quality, including design, construction, maintenance, traffic signage and environmental matters.

The NRA has established an internal organisation structure for the management of its research programme, details of which are available on the NRA website [www.nra.ie/Research/]. The programme is being managed by a dedicated Research Manager advised by an internal network of research mentors drawn from across all the key areas of interest to the Authority.

The principal medium term tasks envisaged for the research function are to:

- i) Establish principal research themes that will contribute in the long-term to the NRA's strategic goals. All individual research tasks will then be structured to contribute to these themes, and all proposed research tasks will be judged against their potential contribution to these themes,
- ii) Establish the contracting methodology with research centres, including procurement and assessment, and put framework contracts in place,
- iii) Commence assessment of research underway elsewhere that would contribute to our needs or eliminate a need for further research in particular areas.

- iv) Establish key assessment parameters and timescale deliverables to ensure congruence of research findings with overall NRA objectives and strategic goals.

Invitation for research proposals

The NRA Research Fellowship Programme is an integral part of the NRA's overall Research Strategy and focuses on fundamental or "blue skies" research projects. The purpose of the Fellowship Programme is to enable universities and institutes to apply for financial support for PhD and post-doctoral programmes covering subjects that are relevant to the aims of the NRA. The Call for Proposals will be specific to research topics identified by the NRA, although other topics outside those specified may be requested for consideration.

Following the successful launch of the NRA Research Fellowship Programme in 2007 and subsequent calls in 2008 and 2009, a number of Fellowships were awarded details of which can be found on the NRA website. It is planned to commission a similar number of PhD / Post-Doctoral Fellowships in 2010. The list of priority topics (including an outline description) for the 2010 NRA Fellowship Programme is included in the Appendix attached here. These topics have been identified by NRA staff in consideration of the strategic goals of the NRA. Topics outside the scope of this list which have relevance to the NRA's core activities may also be submitted for consideration but priority will be given to submissions related to those on the appended list.

Submissions are invited from full time academic staff in third levels universities and institutes. Individuals from industry interested in this Call are encouraged to team up with academic partners in order to participate in the Fellowship Programme. The application must be made in conjunction with a third level institution with a proven track record in the selected area and a detailed knowledge of the particular conditions existing in Ireland. Applicants are encouraged to apply for more than one topic but each submission must be devised as a stand-alone project. The Fellowships will be supervised by appropriate experts in the host university/institute and National Roads Authority personnel. PhD Fellowships will be of three-year duration and Post-Doctoral Fellowships will be one to three years in duration, subject to satisfactory progress being made.

Awards for the Fellowships will be made to the academic institution or equivalent following NRA evaluation. It is envisaged that up to five awards will be made in 2010. Applications will be reviewed and evaluated under the following headings:

- Track record of supervisors
- Technical quality of submission
- Relevance of the research to the goals of the NRA
- Value for money

Applicants are required to give consideration to all the resources (eg, computer equipment, software, etc) associated with setting up the project. An annual budget breakdown for the Fellowship must be provided with each submission. This should comprise a fixed stipend for the candidate (PhD ~€20,000, Post-Doctoral ~€40,000, consistent with the cost structure of the applicant organisation) plus other acceptable costs. A reasonable overhead rate can be included in the project costs consistent with the general policy of the host university / institute: the basis for calculating this should be provided with the submission. Selection of the candidate for the

Fellowship will be the responsibility of the host university / institute using normal selection process.

Fellowship submissions should be made using the template provided by the NRA: this can be downloaded from the NRA website at www.nra.ie/TendersRecruitment/TenderNotices/. Submissions should not be overly-long but should contain sufficient information to enable the project to be fully described and evaluated.

Submissions in hard **and** electronic copy are to be submitted to the NRA by 12:00 on Friday, 14 May 2010. All submissions should be clearly marked for the attention of the NRA Research Manager.

A shortlisting and interview process will follow as required and a decision on Fellowship award will be made by end-July 2010. Projects will start at the beginning of the 2010/11 academic year.

Appendix

Research Topics

NRA Fellowship Programme 2010

Development of LiDAR and its application to an NRA asset information system

NRA Mentor: Brendan Kennedy (email: bkennedy@nra.ie)

Background

LiDAR technology has been steadily improving over the past decade and it is now commonly used at the preliminary stages of civil engineering projects. There has been growing interest in the application of LiDAR surveys to extract roadside inventory information; however from an aerial platform this usually requires a high point density (points per square metre) necessitating lower flying heights and multiple passes which adds to the overall survey cost. Complex algorithms have been developed in order to automatically extract features; however the success rate is limited particularly for objects with a small footprint. The possibility of combining aerial and terrestrial LiDAR surveys merits further investigation. Applications could include the provision of an effective and efficient means of creating a comprehensive representation of the road, surrounding environment and the multitude of assets that exist along the road corridor, thereby providing the location of roadside assets to a very high level of accuracy.

Scope of the project

The objective of this research project is to evaluate the possibility of combining terrestrial and aerial LiDAR surveys to assist in the effective asset management of the various components of the road infrastructure. Aerial LiDAR surveys can be used to create point clouds from which it is possible to automatically extract roadside features. However, the 'hit rate' is very low - approximately 60%. In order to ensure a reasonably high success rate in the extraction of some road side features it is necessary to specify a high number of points per square metre. The focus of this research relates to the possibility of using 'low' density point clouds in combination with terrestrial LiDAR surveys in order to increase the hit rate for automatically extracting roadside features. Inventory items that present difficulties when viewed from an aerial platform present very different 'footprints' when viewed from a ground based platform and by utilising this knowledge it may be possible to develop algorithms that enhance the prospects of automatically extracting features of interest.

The benefits of increasing hit rates on automatic extraction include the ability to create an accurate data repository indicating the location of roadside assets. The LiDAR point cloud could also be used to provide an estimate of the geometry of specific assets and comparisons between repeated surveys over time.

The expected outputs are:

1. New algorithms for the automated extraction of roadside features
2. Inventory of roadside features including spatial and geometric properties
3. An indication of the optimal specification including, number of points per square metre for an aerial survey when done in conjunction with terrestrial survey.

Applications are invited for a PhD / Post-Doctoral Fellowship.

NRA Fellowship Programme 2010

Application of weigh-in-motion systems to the effective management of the Irish national road system

NRA Mentor: Albert Daly (email: adaly@nra.ie)

Background

Weigh-in-motion (WIM) is a method for weighing vehicles without having to stop them on a static weigh-station. There are various technologies used: conventional WIM systems are based on some form of piezo-electric sensor embedded in the road surface while others use a small bridge which is instrumented and calibrated against known vehicle configurations. WIM is used all over the world to collect statistics on vehicle and axle weights. The information can be used to obtain information on general vehicle movements, vehicle overloading and enforcement, pavement design and assessment, and bridge loading and assessment.

The project will focus on currently available systems and how WIM data can be used to provide information the different management systems currently being devised by the Authority.

Scope of the project

The objectives of the project are to review the WIM technology available, to identify appropriate systems for use on Irish roads, and to provide guidance on how best to manage and use the information obtained. The WIM data will be used to characterise the traffic on the Irish national road network. The project will also advise on the procurement, installation and commissioning of up to five WIM systems: it is intended that these will be procured under a separate contract.

Currently, the only information available on the traffic using the national road system comes from counters which only provide numbers of vehicles: no information on axle or vehicle weights is recorded. To effectively manage the road system, it is important that the traffic using the roads is correctly characterised. For example, the level of vehicle overloading in Ireland is not known. This has a particular relevance to road maintenance since pavement wear is proportion to the fourth power (or higher) of wheel loading. This traffic characterisation is also relevant to bridge loading, road safety and the setting of appropriate tolling levels.

An effective weigh-in-motion system would provide the NRA with accurate up-to-date information on axle and vehicle weights currently using the road system. This information would be used to:

- provide reliable information on wheel loading for the NRA's asset management system currently being developed;
- provide information on bridge loading for more accurate assessment;
- provide accurate information on overloading;
- assist in enforcing legal weight limits and thus improve road safety.

Project outputs include:

- Guidance on establishing an effective weigh-in-motion system;
- Procurement and installation of up to five WIM stations;
- Advice on data collection, management and utilisation.

Applications are invited for a PhD / Post-Doctoral Fellowship.

NRA Fellowship Programme 2010

Approaches to the design of noise mitigation measures on national road schemes

NRA Mentor: Vincent O'Malley (email: vomalley@nra.ie)

Background

A recent NRA post-EIA noise evaluation study highlighted a number of issues associated with how noise mitigation measures are designed and implemented on national road schemes. The level of mitigation achieved by some of the current noise barriers designs is often significantly below the required performance standard and the benefits of such a barrier may not even be perceived by the human ear. This is primarily related to the fact that suitable detailed analysis tools have not been identified for the design of noise barriers. Existing standards specify certain acoustic and technical performances which are assessed by the use of tests conducted in a laboratory environment and invariably: these tests are not appropriate for on-site testing. Therefore, current practice does not address installation effects such as topography, profile details, frequency response, material density, etc.

The objective of this proposed project is to identify and assess an appropriate methodology for the optimal design and installation of noise barriers in Ireland. This will include the evaluation of a range of current modelling, monitoring and performance verification techniques. Additionally, the project will include an assessment of the manner in which the acoustic performance of barriers depends on installation effects. Novel barrier designs such as T-top and curved-top barriers will be considered in this study.

Scope of the project

The main issue associated with the design of current noise barriers in Ireland is that they are only required to meet standards as determined in a laboratory environment with regards to their acoustic performance. This performance has never been compared with the performance of a barrier on-site. Additionally, no methodology exists with which the NRA can test the effectiveness of road traffic noise barriers on-site. This project will make this on-site assessment possible, yielding a valuable tool which may be used to improve the overall performance of noise barriers across the entire national road network. The tool could be used to undertake repeated measurements at certain noise barriers which will allow an assessment of the behaviour of noise barriers in the long-term. This information will be quite important in the future design of noise barriers to ensure any potential discrepancies are overcome.

Furthermore, if one considers the NRA's obligations under the Environmental Noise Directive, this methodology may prove a valuable tool in assessing future proposed action plans. While the NRA is not defined as an action-planning authority it holds considerable interest in the development of action plans by relevant local authorities. Additionally, action planning is a cyclical process meaning action plans will have to be reviewed every five years and noise barriers will be the primary mitigation measure considered in achieving noise reductions under such plans. Bearing in mind that the proposed noise action limits, 57dB L_{night} and 70 dB L_{den}, are quite onerous, it is imperative that the NRA have a detailed understanding of noise barrier performance. Where noise barriers are installed, this research will ensure that those barriers are of high quality and will continuously achieve the required levels of mitigation.

This work will ultimately result in a guidance document for future design of noise barriers in addition to the development of a robust in-situ method for determining the acoustic performance of barriers that may be implemented onsite in an effective manner. Such a methodology will have substantial impacts on-site as it will result in improved design of noise

mitigation measures. Additionally the long-term performance of noise barriers may be explicitly quantified, meaning the Authority will have scientific evidence identifying poor-performing noise barriers.

Following the completion of this work, the project will have develop a detailed understanding of noise barriers well beyond the current standard and as such, the NRA will be in a strong position to assess the suitability of proposed barriers along with assessing the performance of current barriers along the national road network.

Expected outputs include:

- An appropriate methodology for the optimal design and installation of noise barriers;
- An evaluation of a range of current modelling, monitoring and performance verification techniques;
- An assessment of the acoustic performance of barriers in relation to installation effects.

Applications are invited for a Post-Doctoral Fellowship.

NRA Fellowship Programme 2010

Low cost solutions for roadside protection

NRA Mentor: Alastair de Beer (email: adebeer@nra.ie)

Background

The NRA currently requires safety barriers be used to protect the motorist from hazards alongside the national road network where the design speed is 85km/h and above. Many National Secondary Roads are located in tourist areas of outstanding natural beauty, where the existing roadside boundary is generally hedgerows and stone walls. Concerns exist with regard to the extent of safety barrier required on these road realignment projects routes: current requirements are specified in NRA standard TD 19. There is a requirement to develop a low cost low maintenance alternative to existing proprietary products currently on the market. There are also concerns that the current barrier products are inappropriate for use on these roads and that it would be desirable to develop more environmentally sensitive, aesthetically pleasing solutions without compromising road safety. The alternative product or works could be incorporated into the NRA Standard Details. As part of the research, it is anticipated that an earth bund would be investigated as a possible low cost alternative to existing barriers. The proposed system would have to comply with existing European Standards, in particular EN 1317 Part 2.

The cost of installation and maintenance of roadside barriers is high. In view of future upgrade programmes for National Secondary Roads, it is desirable to find alternative solutions to conventional barrier systems that have lower initial and maintenance costs. For road upgrade programmes in tourist areas of high scenic beauty, it is appropriate to find alternative solutions which are more aesthetically pleasing and blend in better with the local terrain and environment.

Scope of the project

The research involves the investigation of the safety barriers used on the Irish National Secondary roads. The objective is to achieve low cost and more aesthetically pleasing options to existing proprietary safety barriers for National Roads upgrade projects located in scenic areas. The edge protection solutions must comply with the relevant European Standards, namely, EN 1317 Part 2 and the performance standards required in NRA DMRB standard NRA TD 19/09.

The aim is to develop roadside protection systems which have reduced whole life costs, are environmentally friendly, maintain the integrity of the landscape and are appropriate to the natural beauty of the road. The expected project output is the development of edge protection systems which comply with EN 1317 Part 2 and NRA td 19/09 and which can be installed at low cost, with minimal land take and which are aesthetically pleasing in the context of the Irish landscape.

Applications are invited for a PhD / Post-Doctoral Fellowship.

NRA Fellowship Programme 2010

Assessment of warm mix asphalt for road surfaces

NRA Mentor: Tom Casey (email: tcasey@nra.ie)

Background

Warm-mix asphalt is a term for a variety of technologies that allow the producers of hot-mix asphalt pavement material to lower the temperatures at which the material is mixed and placed on site. Warm mixes provide an opportunity to mix and lay road surfacing at temperatures up to 50C below current specification limits. Such reductions have the obvious benefits of reducing energy consumption and decreasing the production of greenhouse gases. In addition, potential engineering benefits include better compaction on the road, the ability to haul paving mix for longer distances, and the ability to pave at lower temperatures. This is achieved by the addition of modifiers to the base bitumen mix. Whereas some modifiers have a neutral effect, others claim to improve mechanical characteristics such as stiffness. It is not known if the effects are long lasting or their influence on pavement design life. The objective of this research is to determine any long term durability effects on bituminous road surfacings mixed through modification of admixtures used to enable production and laying at lower (ie, "warm mix") temperatures.

Scope of the project

The project involves the investigation of warm mix asphalt products to determine their suitability for use on Irish roads. The research will include an investigation of the short- and long-term material properties of different warm mix materials.

There are a number of advantages to the use of warm mix asphalts. Environmental benefits would accrue through lower temperature mixing and laying of road surfacing material. The use of warm mix asphalt would also improve working conditions for construction and maintenance crew, and local residents. Financial benefits derive through lower production and transport costs. The research is required in order to investigate the long term performance of these materials and produce material specifications for inclusion in the Authority's standards.

The benefits of this research include:

- Contribute to sustainable construction and maintenance of road surfaces;
- Enable informed decisions to be made concerning whole life rather than just initial benefits of warm mixes;
- Reduce the environmental impact of road operations.

The expected outputs of the research should include:

- Specifications for warm mix road surface materials
- Guidelines for production and placement
- Whole life cost model
- Revisions to design charts (if required)
- Cost comparisons between options

Applications are invited for a PhD / Post-Doctoral Fellowship.

NRA Fellowship Programme 2010

Preparing for the future: A reappraisal of archaeo-geophysical surveying on National Road Schemes 2001-2010

NRA Mentor: Ronan Swan (email: rswan@nra.ie)

Background

In the course of funding archaeological work on national road projects, the NRA is concerned about the early identification of major archaeological constraints. Over the past decade the Authority has used a variety of techniques including archaeo-geophysical prospecting to identify such constraints. It is considered timely to review the results of this work and to assess whether such surveys fulfilled their individual objectives and to what extent has this work been of benefit to the Authority. The Authority recognises that such surveys have a wider application as a key source of primary archaeological data, and to make such information accessible, eg, through a database, is in keeping with the Authority's objectives of disseminating information.

It is anticipated that the successful candidate will have a background in archaeo-geophysical surveying and will be able to critically review the existing surveys, and develop and test hypotheses about which archaeo-geophysical techniques and methodologies which are best suited to meeting the Authority's objectives of the early and cost-effective identification of archaeological constraints.

Scope of the project

The Authority has spent a considerable amount of money on archaeo-geophysical surveying on national road schemes throughout Ireland, testing different methodologies and techniques within different regions and different landscape types. The collation and critical review of this data will allow the Authority to determine which are the most techniques represent the best value for money and identify the optimal circumstances for the application of particular techniques. It will also assist in determining whether certain techniques are of value.

The study will also offer the opportunity to return to archaeological sites previously investigated (ie, within the road land-take) and to examine the extent to which the features extend beyond the land-take. This will provide ideal test sites to pilot new techniques and methodologies in a variety of circumstances and conditions. This study will help to inform and shape future testing strategies to ensure that they are viable and cost-effective.

The objectives of the projects are:

1. To assess the efficacy of archaeo-geophysical techniques on national road schemes 2001 to 2010;
2. To develop an accessible database of such archaeo-geophysical surveys which will seek to integrate multiple data sets;
3. To undertake pilot studies using new techniques or adapting existing methodologies;
4. To investigate and test the different variables which impact on a surveys success or failure eg, seasonality, regionality and geology;
5. To provide recommendations to the NRA on the most cost-effective techniques.

Applications are invited for a PhD / Post-Doctoral Fellowship.