UNSW Built Environment

ResearchStart Program 2016

Never Stand Still | Built Environment | Application Form for STAFF

Staff Surname/s:	Hawken, Gusheh, Simon	**Staff First Name/s:**	Scott, Maryam, Katrina
Telephone/Email:	X54747, 0403858162 Scott Hawken		
Your School:	☐ ASA+D ☐ AGSU ☒ Both Schools represented		
Name of the direct supervisor of this project (if other than the applicant or if there is more than one applicant i.e. team application)	Dr Scott Hawken		

Student Career: ***Undergraduate*** ☐ ***Postgraduate Coursework*** ☐ ***Either*** ☒

What types of skills would you prefer student applicants to have? *(Please check all boxes as appropriate)*

Quantitative	**Qualitative**	**Design**	**Other**
☐	☐	☒	☐
SPSS ☐	*Library research skills* ☐	*Digital* ☒	Please state
Excel ☐	*Survey* ☐	*Physical* ☒	
NVivo ☐	*Interview skills* ☐	*Model making* ☒	
GIS ☐		*3D modelling* ☒	

SUMMARY RESEARCH PROJECT INFORMATION

Title of Project	Rapid prototyping of 3D Urban Landscapes : Industry 4.0 for architecture, landscape and urban design

Project description and objectives

The project involves the development of 3D digital model to 3D digital fabrication workflows that can be used as a teaching aids and content for both research and exhibition outputs. Such workflows are essential for "future proofing" students and the environmental design professions more broadly. Such workflows are relevant to landscape architecture, urban design and architectural disciplines and can help develop a foundation for a potential cross-disciplinary undergraduate course building upon existing coursework content by Gusheh ARCH1080, Hawken UDES0009 and Simon LAND1322. This project has three primary objectives –

1. Teaching - Curriculum development for interdisciplinary design studios
2. Exhibition - Content development of 3D printed models and digital visualisations for an exhibition
3. Research – Exploration and optimisation of workflows from digital urban landscape datasets to digital fabrication

The theoretical basis of the project sits within the emerging Industry 4.0 paradigm whereby new digital technologies are transforming the production of manufactured environments and the role of creative professions. Industry 4.0 exists across a range of diverse intersecting innovations that have emerged as a result of digital technologies such as big data, digital analytics, human-machine interfaces and the focus of this project: digital-to-physical transfer (Baur and Wee 2016). Digital to physical transfer involves 3D printing and other technologies that can directly utilize proliferating virtual models to construct physical products and environments. Whereas industrial design is already engaging with such technologies in a fluid way, within the domains of architecture, landscape architecture and urban design, the construction of prototypes and scale models remains a bespoke process outsourced to specialist craft workshops. This project seeks to develop simplified digital workflows to so that digital models can be used to develop rapid scaled urban prototypes.

Although architectural 3D printing is already a reality, with the printing of full scaled houses, such examples are currently an exception and have not been mainstreamed within the profession or architectural education (Gibson 2002). Such processes go beyond simple efficiencies as they are powerful communication devices (Yin 2014), avoiding the miscommunication of spatial relationships and the (often willful) miscommunication of architectural visions through seductive photoshop renderings (Al-Douri 2002). For example the City of Sydney requires new development applications within the Central Sydney to submit a 1:500 scale built model along with 2D documentation. Futhermore such workflows have the potential to change the performance and form of our cities for the better (Tang 2014)

Methodology

3D digital models of cities are being generated around the world. Such models are available in various formats – most commonly GIS and CityGML formats. This project uses this raw data as a template for the generation of STL files necessary to make 3D prints. A variety of software is available for such prints and usually a sequence of different software's is necessary to prepare quality STL files from the diverse city model data. The project methodology involves streamlining this process so that clean STL files can be generated efficiently from 3D city digital models.

STL files for rapid prototyping can be used to print various models using liquid polymers which harden in layered "slices" to form solid plastic models, others use powders to form metal models, while others use special waxes. The UNSW BE Fab labs have two various types of 3D printers that produce paper models and plastic models. More industrial scale commercial 3D printers are also available in Parramatta. Critical in all these applications is that the STL files must form a complete, closed surface without anomalies. There is proprietary maker software designed to check for anomalies.

The production of 3D prints is not a straightforward process and requires experimentation and streamlining of the prototyping process. It is proposed that the student use the Michael Crouch Innovation Centre maker space which has permanent helpful staff supervising the labs at all times, to assist with the generation of an efficient workflow. The successful student will be required to meet and engage with the MCIC staff and develop a positive working relationship with them. Meetings with Hawken/Gusheh/Katrina will initially be weekly then fortnightly.

Expected project outputs

Expected project outputs include a series of digital visualisations of 1. urban landform, 2. cityscapes and 3. architectural buildings demonstrating the relationship between landform, urban form, and architecture. These three components will be developed as separate but interlocking components.

Sydney will be used as a case study with three to five scale models being developed of sections of the central business district, its landform and architecturally award winning buildings of the last five years. Buildings selected should be those that have been developed from Sydney City Competitive Design Policy, adopted by the Council in for the CBD in 2000 and for the wider city since 2012 to improve the design outcomes (Freestone et al 2015). The scale of the model will be guided by the size of the 3D printer although larger scales may be possible if the model is designed and developed in sections.

References:

Al-Douri, Firas A. 2010. "The Impact of 3D Modeling Function Usage on the Design Content of Urban Design Plans in US Cities." *Environment and Planning B: Planning and Design* 37 (1): 75–98. doi:10.1068/b35055.

Baur, Cornelius, and Dominik Wee. 2016. "Manufacturing's next Act | McKinsey & Company." Accessed April 19. http://www.mckinsey.com/business-functions/operations/our-insights/manufacturings-next-act.

Freestone, Robert, Gethin Davison, Richard Hu, and Sarah Baker. 2015. "The Regulation of Excellence: Design Competitions in Sydney." In State of Australian Cities National Conference 2015, Gold Coast, Queensland. http://soacconference.com.au/wp-content/uploads/2016/02/Freestone..pdf

Gibson, Ian, Thomas Kvan, and Ling Wai Ming. 2002. "Rapid Prototyping for Architectural Models." *Rapid Prototyping Journal* 8 (2): 91–95. doi:10.1108/13552540210420961

Tang, Ming, and Jonathon Anderson. 2014. "Information Urbanism: Parametric Urbanism in Junction with GIS Data Processing & Fabrication." *ARCC Conference Repository,* http://www.arcc-journal.org/index.php/repository/article/view/373

Yin, Li, and Narushige Shiode. 2014. "3D Spatial-Temporal GIS Modeling of Urban Environments to Support Design and Planning Processes." *Journal of Urbanism: International Research on Placemaking and Urban Sustainability* 7 (2): 152–169.

Student responsibilities

The production of 3D prints is not a straightforward process and takes experimentation and streamlining of the prototyping process. It is proposed that the student use the Michael Crouch Innovation Centre maker space which has permanent helpful staff supervising the labs at all times, to generate an efficient workflow. The student successful student will be required to meet and engage with the MCIC staff and develop a positive working relationship with them.
This project offers students the opportunity to experiment with the translation of digital data into 3D visualisations and fabrications. Responsibilities include the following :

- Develop 3D digital models of urban landscapes
- Export to STL format and validate models in readiness for 3D printing
- Setup and monitor 3D printing process
- Test both consumer and commercial 3D printing processes
- Experiment with different 3D printing and digital manufacturing types
- Produce a series of 5 exhibition standard 3D printed models with accompanying 2D prints of 3D visualisations
- Record workflow in a clear series of documents that can be used as a teaching aid for future students. This is to be uploaded as a web resource to the faculty website.

Minimum student qualifications

This project requires applicants with a well-developed visual aesthetic and the ability to translate digital data and drawings into three dimensional visualisations and excellent built models. Applicants must submit a portfolio demonstrating 3D digital and physical modelling capabilities. Capacity in specific software is not necessary although a willingness to learn new software and processes are a requirement.

*Application must be submitted by **15 April 2016**, **fbe.ade.office@unsw.edu.au***

Associate Professor Oya Demirbilek
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