

Design 5 presents an introduction to complex architectural thinking. It examines both conceptual and exceptional spaces and develops an understanding of corresponding architectural methodologies and systems. Topics will explore the cutting edge of architecture, with an individual emphasis on the theoretical, contextual, architectonic, communicative, material, spatial, sociological or topographical.

Uwe Rieger & Yinan Liu

Uwe Rieger is co-founder of the Berlin-based interdisciplinary group kunst + technik (art and technology) and the architecture office XTH-berlin. His work is focused on responsive architectural systems using mixed reality concepts. His projects have been internationally published, and exhibited at renown institutions such as t the Museum of Modern Art Barcelona (Spain), the National Museum of Indonesia, Expo 2000 (Germany), the International Building Exhibition IBA (Germany), the Ars Electronica Festival (Austria) and the National Museum of New Zealand Te Papa Tongarewa.

Uwe is Associate Professor for Design and Design Technology and is heading the arc/sec Lab for Digital Spatial Operations at the University of Auckland

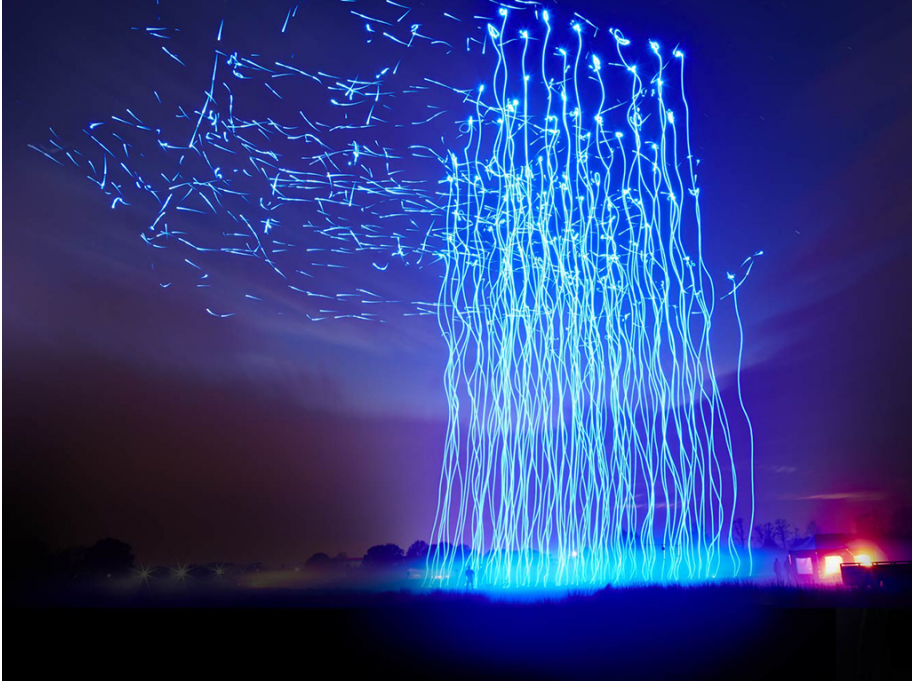
Yinan Liu is an architectural graduate from the University of Auckland.

Since beginning of 2017, she has been the Coordinator of the Digital Research Hub at the School of Architecture and Planning and the lead technologist at the arc/sec Lab for Spatial Digital Operations. Her artistic work have been presented at Q-theatre and the Ars Electronica Festival (Austria)

arc/sec
LAB FOR DIGITAL SPATIAL OPERATIONS

www.arc-sec.com

TACTILE DRONES-!-



1. *Spaxel Drones* at Ars Electronica 2016

GENERAL COURSE INFORMATION

Course :	Design 5 ARCHDES300
Points Value:	30 points
Course Director:	Sarosh Mulla: s.mulla@auckland.ac.nz
Course Co-ordinator:	Uwe Rieger: u.rieger@auckland.ac.nz
Studio Teacher:	Uwe Rieger & Yinan Liu
Contact:	u.rieger@auckland.ac.nz yinan.liu@auckland.ac.nz
Location:	Level 1 studios + XR Lab R149 + Drone Arena
Hours:	Monday and Thursday 1:00-5:00pm

Tactile Drones -:-

A joint project between the arc/sec Lab for Digital Spatial Operations and the Research Group for Dynamics and Control at the Department of Mechanical Engineering.

Drone technologies and their adjoined control systems have rapidly advanced over the past decade. In an architectural context, drones are typically used for the scanning of sites, the maintenance of buildings, the creation of flying light sculptures, the assembly of structures and flight controlled 3D printing. Usually these are preprogrammed processes, once activated, they follow a predefined program with people separated through safety measures such as nets or defined flight zones.



2. *Flight Assembled Architecture* by Gramazio & Kohler and Raffaello d'Andrea, FRAC Centre in Orléans, 2011
3. *Cyber Physical Macro Material as a UAV [re]configurable Architectural System*, Thesis Project by Miguel Aflalo, Jingcheng Chen, Behrooz Tahanzadeh, University of Stuttgart, 2018
4. *Drone Skyscraper* by Hadeel Ayed Mohammad, Yifeng Zhao and Chengda Zhu, eVolo 2016

The Tactile Drones -:- Studio will take a further step. Working closely with Dr Karl Stol and a team of Engineering students from the Dynamics and Control Research Group, we will develop strategies on how drones can work alongside and in direct contact with humans. The aim is to make drones sensitive to human touch and physical human interference. Combined with the deep knowledge on Augmented Reality (AR) technologies, Mixed Reality (MR) systems and Cross Reality (XR) applications that we have assembled at the **arc/sec Lab** for Digital Spatial Operations, we will explore new concepts for user-responsive drones and their application for architectural purposes.

Tactile Drones -:- will combine kinetic physical objects with dynamic digital information. Our collaborative explorations will enter new territory in design and construction. We will have regular fortnight meetings and workshops with the engineering team which will work on algorithms to control the human interaction and flight behaviour of the drones. Our architecture team will explore and create new functionalities by combining the drones with latest cross reality technologies. This will include the work with Augmented Reality headsets, motion capture systems, sensor systems and real-time render software. The driving vehicle for our investigation will be 1:1 tests in the drone arena at Engineering and the XR Lab at the Architecture School.



5. *MUPPette* - 3D printing drone by Gensler's, Los Angeles 2016

6. *Mud Shell*, mud spaying drones by Stephanie Chaltiel, London Design Festival 2018

7. *Paint by Drone*, Carlo Ratti Associati Architects, 2017

Tactile Drones -:- is not a speculative design project. We are aiming to achieve fully functional setups. These are envisaged to be highly esthetical performative presentations which will be used for both, to test ideas and to convincingly communicate our findings to a public audience. A first opportunity will be the Digital Aurora Exhibition hosted by the Newmarket Innovation Precinct in November 2019. The exhibition is organized by UoA and assembles experimental interdisciplinary works that are emerging at the cross-section of technology, art and culture.

The studio will be structured as a research group. The common goal to investigate new functions, aesthetics and user interaction in hybrid environments. By introducing and experimenting with cutting edge technology, the Tactile Drones -:- Studio is setup with two goals in mind:

1. To actively contribute to the development of new knowledge in the research field of *Real Time Reactive Architecture*
2. To equip the participants of this studio with unique professional skill sets for contemporary architectural practice, which increasingly requires the creative and productive use of advanced digital technologies.

Pre-Requisites

The studio does not require any pre-knowledge on specific technologies or programming. Only curiosity and interest is needed. The -:- studio will be supported by the Digital Research Hub (DRH) and we will run a series of workshops to introduce the gaming engine *Unity 3D*, the motion capture systems OptiTrack, AR headsets, 3D projection systems and digital fabrication technologies.

Studio Structure

We will be working as a research team. Together we will explore a new field of hybrid designs. Through the principle of collective learning, we are aiming to produce new knowledge and ideas on haptic-digital constructions. While our approach is highly experimental, we are working towards applied outcomes. Our goal is to demonstrate the results through fully functional prototypes. As aesthetically pleasing projects, they are expected to be of highest quality in respect to: design, physical fabrication, digital graphics and interactive behaviour. In order to achieve this complex aim, we hope to assemble a strong design research team that consists of individuals with different skill sets and specialities.

Consider joining the -:- studio if you are interested in one or more of the following:

- Graphic design
- 3D animations
- Model building
- Architectural construction
- Performative design
- Interaction design
- Programming
- Technology

TOPIC STRUCTURE AND CONTENT

Research Lab

The project is embedded into the ongoing research at the **arc/sec Lab for Digital Spatial Operations**. The lab connects long term research projects with undergraduate and postgraduate courses. Collectively we explore concepts of Real Time *Reactive Architecture* through a fusion of the digital and physical world.

The arc/sec Lab utilizes interactive installations as the driving vehicle for the exploration and communication of new dimensions in architectural space. The Lab's research is a starting point for both, the development of practice oriented applications and the speculation of how our cities and buildings might change in the future. (see www.arc-sec.com)

Work Form

The studio will consist of both, teamwork and individual work. We will focus on four areas of investigation:

- Technology - exploring innovative use of a variety of digital spatial technologies
- Fabrication - producing high-quality objects with a specific focus on detailing and materiality
- Human Computer Interaction - development of new user interfaces
- Aesthetics - design of fully functional hybrid designs including interactive behaviour

In the first part of the semester we will work in small teams with allocated tasks to assemble knowledge in the area of:

- Advanced digital and physical model building
- XR display principles
- Projection technologies
- Motion based tracking
- Drone technology
- Sensor technology
- User interaction

In the second part, we will concentrate on the development of the final projects. The areas of investigations will be pre-categorized to cover a series of research questions. You may choose to work individually or in small teams with defined individual tasks.

Week	Date	Event
Week 1	Mon 4.3 Thu 7.3	12:00 All architecture meeting, r 311 2:15 Design 5 staff presentations and ballot Overview Tangible Data Engineering Workshop (tbc)
Week 2	Mon 11.3 Thu 14.3	Drone Workshop Graphics : DRH I digital workshop II; Basic Animations in Unity
Week 3	Mon 18.3 Thu 21.3	Tracking DRH : digital workshop III : Tracking / actions in Unity
Week 4	Mon 25.3 Thu 28.3	Tests AR and projection surfaces: DRH digital workshop IV : Projection and calibration
Week 5	Mon 1.4 Thu 4.4	Concept development
Week 6	Mon 8.4 Thu 11.4	Design 5 Mid-semester crits
MID-SEMESTER BREAK		
Week 7	Tue 29.4 Thu 2.5	Interactive components DRH digital workshop V : Advanced animations in Unity Concept finalization; Cross crits

Week 8	Mon 6.5 Thu 9.5	Research and construction phase: DRH : I digital workshop VI (if required)
Week 9	Mon 13.5 Thu 16.5	Research and construction phase
Week 10	Mon 20.5 Thu 23.5	Final construction phase
Week 11	Mon 27.5 Thu 30.5	Final construction phase
Week 12	Mon 3.6 Thu 6.6	Final Presentation Design 5 Final Studio Reviews

RESOURCES

Unity online tutorials

The studio is supported by DRH (Digital Research Hub)

REQUIRED PRODUCTION

In the first part of the semester we will build physical and digital models, develop high-end graphics, experiment with sensors and program interactive behaviour.

The final presentation will consist of 3 parts:

1. The demonstration of a Tactile Drone performance
2. A pdf presentation on principles and findings reacted to the presented object (drawings, images and videos)
3. The hand in of an individual A4 report with a focus development of your work throughout the project (drawings, photos and a condensed text).

ASSESSMENT & FEEDBACK

This course is assessed as 100% coursework. Conversational feedback is given throughout the semester. Written feedback, with indicative grading, is given at a date around the mid-point of the

semester. All further information regarding assessment is available in the ARCHDES 300 Design 5 Course Outline (on Canvas).

LEARNING OUTCOMES

General Course Outcomes: On successful completion of this course students should be able to:

- Theory: Show evidence of engagement with selected / prescribed areas of architectural theory and knowledge. Further, to show evidence of the exploration of the possible influence of this upon the development of architectural propositions.
- Architectonics: Demonstrate abilities to project, explore and develop the tectonic characteristics of the project through the creative engagement with material, structural or constructional propositions.
- Programme: Show evidence of engagement with identified cultural, social and functional positions as they might inform speculative architectural propositions.
- Performance: Show abilities to advance conceptual thinking through engagement with environmental and contextual conditions that could bear upon the project, and to examine the way in which the architecture may affect those same conditions in return.
- Form and space: Demonstrate abilities to develop speculative three dimensional architectural form and space.
- Media: Display skill in the communication and development of design propositions through the considered use of architectural media.

Specific Topic Outcomes: This studio topic will engage the general course outcomes in the following ways:

- Theory: To gain an understanding of the concept of *Tangible Data* and its relationship to dynamic architectural space and user interaction
- Architectonics: To explore new architectural applications for the fusion of physical and digital construction
- Performance: To develop an understanding of responsive environments, user behaviour and navigation.

- Form and space: To explore the point where the technical and aesthetic aspects of Tangible Data meet to create the discipline of architecture
- Media: To develop an interactive project and to test and communicate both, inspirational visions and applied functionality. Aesthetical emphasis is given on both, a well fabricated physical components and the interactive graphical interface