

# Mech Connect

## UC Mechanical Engineering

Newsletter for our Alumni & Friends, Winter 2019

## Head of Department

Dear All,

As you may know, I have been the Head of Department for Mechanical Engineering since the beginning of April. It is a great honour and responsibility for me and I look forward to the challenge of stirring the department to ensure that it remains to be a place where we train future generations of strong mechanical engineers, where staff enjoy their work, and where cutting-edge research is done.

The Alumni reunion last April was a great opportunity to reconnect with many of our former graduates spanning several decades and listen to inspirational speakers. We definitely plan to do it again in the near future and hope to see many of you on that occasion.

Our Mechanical Engineering programme is currently in the process of being reaccredited by Engineering New Zealand, giving our graduates a very important seal of quality. Our curriculum is also evolving with the recent introduction of the Biomedical Minor that aligns well with a research strength of the department and new courses such as *Material Failure Analysis* and *Industry 4.0: Advanced Manufacturing*.

I hope you enjoy reading the latest news and achievements from our department and hope to hear from you if you have any information you would like to share with the UC Mech community.

Stay connected,  
Mathieu



Prof Mathieu Sellier

# Alumni Reunion

## Welcome back alumni!



Over the weekend of 13–14 April, UC Mechanical Engineering welcomed back alumni and former campus staff for the first alumni reunion since 2010. Former HOD and current Dean of Engineering, Shayne Gooch, welcomed guests back to UC and gave everyone a quick overview on recent developments in the department...

# Welcome back alumni!



**...This included highlighting recent research activities and successes, student achievements, as well as new programme developments. He also spoke about the new labs completed in 2018 as part of the Canterbury Engineering the Future (CETF) rebuild project. This program provided a \$163 million investment in new facilities across Engineering.**

**Prof Mathieu Sellier, our new Head of Department** since April 2019, also welcomed guests and cast the vision where the department is heading for the future.

The programme included four engaging talks by current staff members. **Prof Keith Alexander told The Trampoline Story**, about how his innovative idea and design for the *Springfree* trampoline led to it being US Child Product of the Year in 2010.

**Dr Debbie Munro spoke about plans for the new Biomedical Engineering minor** as part of the Mechanical Engineering degree, set to launch in 2020. **Bruce Robertson spoke about Formula Student race car design and competitions**, and what he's learnt from working with engineering

students. Finally, **Prof Geoff Rodgers gave a talk on mechanical engineering design for earthquake engineering**, and how this award-winning research has been applied to buildings in and around Christchurch as well as overseas.

**Alumni toured the new lab facilities**, including materials and thermodynamics, advanced manufacturing and design, aerodynamics with the wind tunnel, mechatronics lab and three mechanical workshops (<https://www.canterbury.ac.nz/engineering/schools/mechanical/alumniupdate/reunion2019/>). Staff were on hand to run a few demos and talk about current research projects. Formula Student race cars, the Virtual Reality race car, and the Eco Marathon car were on display, and guests got a first-hand look at the world's first 3D-printed titanium engine used in the Shell Eco-Marathon race in Singapore in 2018. This was the first time some alumni had been in the labs in over 40 years, and many commented on how much has changed.

A highlight of Saturday evening was UC alumnus guest speaker **Steve Gurney (Mechanical Engineering, 1986)**. In this very inspiring talk, he revealed how he used his engineering skills to win races and come up with innovative solutions used in his sporting endeavours.

On Sunday 14 April, alumni went on a **tour through Christchurch** with a full commentary on the rebuild since the earthquakes, including stops at the new *Turanga* central library, Christ Church Cathedral, and the old UC campus, which

is now the Arts Centre in Christchurch. The route included a drive through the red zone and past buildings damaged in the earthquake, the Transitional (cardboard) Cathedral, the old AMI stadium, the new Justice Precinct, the new Health Precinct, Te Pae Convention and Exhibition Centre, and new buildings and developments in the CBD. It also included a few "behind the scenes" stories of UC research being applied to rebuild projects.

*If you plan on organising a class reunion please do not hesitate to contact [mechpublicity@canterbury.ac.nz](mailto:mechpublicity@canterbury.ac.nz) and we can help organise a tour of the Mechanical Engineering labs. We can also work with the UC Alumni office to help source details of classmates you may have lost contact with and put you in touch.*

We'd like to thank our sponsors for helping make this event possible.

  
HamiltonJet

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engineering new zealand **CANTERBURY**

**FISHER & PAYKEL**

# Our Staff

Dr. Mark Garnich came to the department in 2017. A/Prof Garnich grew up in Washington State, USA where his father imparted a strong appreciation of the outdoors through tramping, camping, hunting, fishing, and a general enthusiasm for nature. The allure of an entirely new array of places and wild things partly motivated the move to NZ.

Dr. Garnich obtained his Bachelor and Master degrees at Michigan Technological University and his PhD in Mechanical Engineering from the University of Wyoming in 1996. Over the years, the common denominator in his research has been computer modeling, starting with his Masters research writing a computer program to model the vehicle suspension dynamics of a tracked vehicle. He spent 15 years at Pacific Northwest National Laboratory working on a variety of projects. Examples include; ballistic projectile analysis and design optimization under interior ballistic conditions, analysis of superplastic forming of sheet metals, multi-

physics analysis of electromagnetic (high rate) sheet metal forming, coupled electromagnetic-thermal-flow modeling of a cold wall induction melter, and transient thermal analysis of in situ vitrification of soil containing hazardous waste.

Prior to UC, Dr. Garnich was an A/Prof at the University of Wyoming where his research was focused on multiscale modeling of composite materials. He is one of the founders of multi-continuum theory, a unique multiscale approach to stress and failure analysis of composite structures. He developed a small business (Firehole Technologies; sold to AutoDesk, Inc. in 2013) focused on application of the theory mainly for the aerospace industry. The modeling theme continues at UC where he has taken on a former civil engineering student to model Buckling Restrained Braces (BRBs) used as earthquake resistant reinforcement of buildings and a student from the US who is modeling dynamics and heat transfer in sporting firearms with a goal of better understanding sources of inaccuracy.



A/Prof Mark Garnich

# Recent Achievements



< Prof Geoff Rodgers in front of Tūranga Library in Christchurch, where his damper technology has been used.

## New damper technology for earthquake-safe buildings

### UC engineering innovation boosts new city library's quake resilience.

Christchurch's new state-of-the-art central city library incorporates innovative UC engineering solutions designed to help it endure a large earthquake with minimal damage. In March 2016, the Southbase-led design and build team behind the city's flagship five-storey library, Tūranga, began mapping out how they would achieve a high level of earthquake resiliency. Getting the right structural engineering solution for Tūranga –

the largest public library in the South Island – is crucial to ensuring its future seismic resilience. UC Mechanical Engineering Professor Geoff Rodgers leads the field in alternative systems that use dampers to both absorb energy in a big earthquake and prevent building damage. The conventional approach would have been to incorporate sacrificial design features to absorb energy and prevent building collapse. For further reading: <https://www.canterbury.ac.nz/news/2018/uc-engineering-innovation-boosts-new-city-libraries-quake-resilience.html>

### Safer, more cost-effective design.

As a safer, more cost-effective, alternative he had developed a low-damage structural engineering design solution for Forté Health's new building in central Christchurch, where 96 extrusion dampers were installed throughout the building's structure. Larger extrusion dampers have been strategically bolted between key base walls and the foundation to act as motion restraints in the event of a large earthquake. In summary, 20 dampers have been used, a metre long and 185 kg in mass. "Under a low level of shaking, this building will respond just like a fixed base structure. Once you get beyond that low level of shaking, it has been designed to roll and move at the base but in a controlled way," Rodgers says.

### Full prototype testing

Prototype testing was performed using a pre-cast concrete building mounted to one of the world's largest and flexible shake tables, housed at the International Joint Research Laboratory of Earthquake Engineering (ILEE) at Tongji University, China. Access to this shake table was facilitated by the 2016 partnership of ILEE and UC QuakeCoRE. UC researchers were able to test a whole building (10m x 6m and 8m high) on ILEE's shake table, rather than individual components. This gives QuakeCoRE researchers, like Geoff Rodgers, the ability to create realistic testing environments.

# Recent Awards



< Prof Chase (centre) and Dr Zhou (2<sup>nd</sup> from left) with Prof Xu (2<sup>nd</sup> from right) and colleagues from the Department of Astronautics at NPU after Prof Chase's award.

"The award of an Honorary Professorship is a great honour from such a top university and department. I look forward to continuing to work with Prof Xu and NPU via the new research centre at both the Xi'an and Taicang campuses", Prof Chase says.

While Professor Chase and Dr Zhou regaled the attendees of the Department of Astronautics and Aerospace at NPU Xi'an, NTU, and NPU Taicang, with a series of seminars, Dr. Zhou, also got the opportunity to show off his world leading research achievements at the NPU Young Scholars Forum for top young engineering researchers. This forum aimed to attract outstanding young researchers and promote research exchanges globally on original and cutting-edge innovative research. Dr Zhou was also invited to give a research seminar in the Department of Astronautics on his recent results of digital clones for integrated structural health monitoring. He has been working on the next generation of optimized decision-making structural health monitoring (SHM) for building structures using automated digital clones since 2013 at UC.

"Structural health monitoring was first developed in the field of aerospace and extended to Earthquake Engineering. It was a great privilege to give the invited talk of SHM in this top aerospace school and unique opportunity to share and discuss our research work with other top researchers in this interdisciplinary research field", says Dr Zhou.



Prof Chase receives the award from Prof Weihong Zhang the Vice Chancellor of NPU

## UC engineer awarded honorary professorship in China

In April 2019, Distinguished Professor Geoff Chase was awarded an Honorary Professorship of Engineering, as part of the Astronautics Department at the Northwest Polytechnic University (NPU) in Xi'an, China. NPU is one of the top 5 engineering schools in China and a leader in Astronautics and Aerospace Engineering. His Professorship at NPU includes deputy leadership of a new Centre for Intelligent Monitoring and Maintenance with Prof Chao Xu.



# Recent Achievements

## Going where no robots have gone before

Invert Robotics, a company originating from within UC's School of Engineering, picked up \$13 million of investment from a global syndicate of investors led by Finistere Ventures and Yamaha Motor Ventures. This innovative company, started and staffed by UC grads, have developed a climbing robot that can stick to non-magnetic surfaces. This is accomplished through an

adhesion mechanism akin to an array of small suction cups that requires very little energy input. Aside from the ability to scale non-magnetic surfaces, the companies robot features camera-based surveillance and can perform structural scans using surface-wave detection techniques and ultrasonic probes.

One of Invert Robotics' machines clings to an aircraft's fuselage >



## Keep up to date

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**Alumni space:**

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