

## **PRESS RELEASE**

16 July 2019

Stellenbosch University

# **Stellenbosch engineering students continue studies about SA's polar research ship**

### **Highlights:**

- \* Stellenbosch University (SU) engineers have been involved in research about the ship itself since the commissioning of the SA Agulhas II in 2012.
- \* Four SU engineering students will leave Cape Town aboard the ship this week. They will study how the ship's steel structure responds to the slamming of waves as it navigates rough seas, and how passengers experience the subsequent vibrations and movements caused by the wave action and ship engines.
- \* One student's grandfather regularly travelled aboard SAA II's predecessor to do maintenance work on South African research islands and in Antarctica.
- \* Another student is a member of the Maties Women Cricket Team.

[copy]

The (icy) adventure of a lifetime awaits four Stellenbosch University (SU) engineering students who will leave Cape Town aboard South Africa's SA Agulhas II polar supply and research vessel. Their research work commences as soon as the ship leaves the harbour on Thursday 18 August, because the students are aboard to investigate the vessel itself.

Armand van Zuydam of East London, Nicole Taylor of Stellenbosch, Martinique Engelbrecht of Concordia in the Northern Cape and Jesslyn Bossau of Windhoek in Namibia are working towards masters degrees in mechanical or mechatronic engineering. The four students are part of the Sound and Vibration Research Group of the SU Department of Mechanical and Mechatronic Engineering, under leadership of director Prof Annie Bekker.

Their mission is to study how the steel structure of the SA Agulhas II responds to the slamming of waves as it navigates rough seas towards the polar regions, and how passengers experience the subsequent vibrations and movements caused by the wave action and ship engines. The focus is on measuring full-scale vibration, how the ship's shafts are twisted by ice- and water- interaction with the propellers, and how people experience such vibrations.

"In this new era of data and industry 4.0 these measurements are aimed at progressing beyond hindsight, but further forward towards the development of systems by which ship and human responses can be monitored and predicted," explains Prof Bekker.

Around 200 different measurements will be taken during the course of the upcoming voyage to collect real-time data. During the past few weeks, the students have already put in place specifically designed sensors and computer software for this purpose.

"A unique aspect of this instrumentation is a 30 sensor acceleration system, which was custom developed by Stellenbosch University. This enables researchers to track the displacement and deformation of the ship's structure as she encounters the harsh environment," explains Prof Bekker.

The students' work is part of an ongoing monitoring project of the ship which commenced in 2012 when the then newly built vessel undertook its first ice tests in the Baltic Sea. Stellenbosch University has been part of

the research project since its inception and continues the work in conjunction with Aalto University in Finland. The research is funded by South Africa's National Research Foundation, and the Academy of Finland.

"The Department of Environmental Affairs and the South African National Antarctic Programme (SANAP) enable this research through availing berth space and crew support which is crucial to the success of this project," adds Prof Bekker.

She says the SA Agulhas II is currently the only polar supply and research vessel travelling on the world's icy oceans to be monitored in such great detail. All information gathered over the past seven years is open source and available. It is much more comprehensive than commercial data due to the level of detail (time resolution) and extended time frames involved.

"The SAA II was the first vessel in her class to be built according to a set of international SOLAS rules from 2009 about the safety and comfort of passenger ships. As such her design provides valuable operational experience towards the commissioning of other polar supply and research vessels by other countries," Prof Bekker wrote in a recent article she was the lead author of in the journal *Ship Technology Research*. "In a world where climatic changes are probable, and where the prediction of such changes relies greatly on knowledge and understanding of the ocean, the SAA II is strategic as a world-class research platform."

Prof Bekker's team have over the past few years already measured aspects such as the pressure of the ice, and the resulting force it has on the ship's hull and propulsion system, ice-induced structural vibrations and noise, whole-body vibration comfort, ship dynamics in ice, global ice loads, underwater noise and mechanical and physical sea ice properties.

### **In grandfather's footsteps**

The students involved are excited about the trip of more than three weeks that awaits them. For Nicole Taylor, it also holds sentimental value. Her grandfather, Constant McLachlan, was a passenger on board the SA Agulhas II's predecessor, on numerous expeditions to Antarctica and South Africa's research islands where he helped with maintenance and construction work.

"My 'Oupa' went on many voyages on the SA Agulhas I. It is a privilege for me to be one of the next generations aboard the next generation of the SA Agulhas," notes Nicole, who matriculated from Rhenish Girls' High in Stellenbosch in 2014.

She will assist in conducting surveys to find out how crew members and passengers experience the continuous movement and vibrations of the ship under different weather and wave conditions. She will also conduct vibration measurements and observe how the vessel travels through ice and waves.

"This voyage will help us better understand how passengers experience living and working on a ship," she notes.

As part of her masters thesis, she is developing a human digital twin for passengers on board a polar research vessel such as the SA Agulhas II.

A human digital twin is a virtual counterpart of a human on a ship. It captures various information about people's state on board, to tell whether someone is suffering severe discomfort, is susceptible to sea sickness, might be woken by waves slamming or cannot perform his or her job on board the ship.

"The information that a human digital twin provides can help ship captains make tactical, strategic and operational decisions to ensure the safety and productivity of their passengers and crew. For instance, a captain learning that passengers are unpleasantly uncomfortable could to change the orientation of the ship with regards to its position towards incoming waves," Taylor explains.

### **Wave slamming**

Namibian Jesslyn Bossau is looking forward to seeing the beauty of an icy landscape, to form new friendships and to learn from other researchers on board the vessel.

“I am excited to be able to admire the changeable ocean on a daily basis and expect to be humbled by the immense power of the waves,” says Bossau, who matriculated from St Paul’s College in Windhoek.

The experience will provide her with her first real encounter with wave slamming – a phenomenon that she has been researching for the past year. Bossau will take measurements which determine how the ship accelerates, when it is hit by waves and how these impacts propagate through the vessel structure.

“My project aims to identify, classify and rate slamming events using signal processing techniques to extract the wave slamming events from the acceleration data that is recorded,” she explains.

### **Scaled model of ship**

Armand van Zuydam is building a scaled model of the ship. Once completed, it will be tested in a special water-filled towing tank available in the Department of Mechanical and Mechatronic Engineering at Stellenbosch University where wave motion can be artificially generated. The scale model and specific computational software will be used to simulate how the ship reacts in the water when travelling through different sized waves and carrying different loads.

“Wave slamming occurs when a vessel’s bow or stern emerges from a wave and re-enters the water with a heavy impact. It greatly influences the comfort of passengers and crew members aboard a ship,” explains van Zuydam, who matriculated from Grens High School in East London in 2014.

“I am excited but at the same time slightly terrified to encounter big swells in the Southern Ocean,” admits Armand, who will be packing his trusty coffee maker to ensure some additional human comforts while away from home.

### **A game of cricket**

The experience is worlds apart from Concordia near Springbok in the Northern Cape where Martinique Engelbrecht grew up and matriculated in 2013.

She is developing mathematical models with which to predict how comfortable people are on board a ship, and how different sized waves and weather conditions influence their ability to continue with their work and other activities.

“Such models can be used along with detection and prediction algorithms to develop a ship-human interaction digital twin and to gain insights into how people perceive vibrations on board,” says Engelbrecht, who believes that the research is helping South Africa to stake a claim in the international marine industry.

Engelbrecht, a member of the Maties Cricket Club, also has her sights on a more sporty matter: “I want to be one of the few people who can say that they’ve played cricket in the middle of the Southern Ocean!”  
[end]

## **Background: the SA Agulhas II:**

- It is owned by the South African Department of Environmental Affairs and is used for annual research and re-supply voyages to Gough Island, Marion Island and Antarctica.
- It was manufactured in Finland in 2012.
- It is just over 121 meters long, and 21,7 meters wide.
- It can accommodate 44 crew members and 100 passengers. Passengers are generally scientists who are unaccustomed to being on the ocean.

### **Photo caption:**

The four engineering students from Stellenbosch University ready to conduct research on the SA Agulhas II polar vessel is Armand van Zuydam, Jesslyn Bossau, Nicole Taylor and Martinique Engelbrecht. Photo: US

**NOTE: There will also be students in earth sciences from Stellenbosch University on board the SA Agulhas II. WIID A TO PROVIDE**

**For media enquiries only (PLEASE DO NOT REPRINT)**

Prof Annie Bekker  
Director: Sound and Vibration Research Group  
Department of Mechanical and Mechatronic Engineering  
Stellenbosch University  
082 8782698  
[annieb@sun.ac.za](mailto:annieb@sun.ac.za)

**Contact details of engineering students on board:**

Armand van Zuydam  
[19190107@sun.ac.za](mailto:19190107@sun.ac.za)  
0820610778

Nicole Taylor  
[nctaylor@sun.ac.za](mailto:nctaylor@sun.ac.za)  
0836677208

Martinique Engelbrecht  
[martiniqueengelbrecht@gmail.com](mailto:martiniqueengelbrecht@gmail.com) [18503950@sun.ac.za](mailto:18503950@sun.ac.za)  
078 664 5255

Jesslyn Bossau  
[19038968@sun.ac.za](mailto:19038968@sun.ac.za)

---

Released for Stellenbosch University by Martin Viljoen (021) 808 4921 or [viljoenm@sun.ac.za](mailto:viljoenm@sun.ac.za)  
Written by Engela Duvenage