RESEARCH OPPORTUNITIES

UCT Electrical Engineering

Radar Remote Sensing Group (RRSG)
&
Software Defined Radio Group (SDRG)

Agenda

- Research: why should you prolong the agony?
- What is radar and hpc and vlsi-design (why its awesome)?: 10-15min
- Our activities in radar: 10-15min
- Our activities in hpc: 10-15min
- Funding opportunities: 10-15min
- Q&A: 10-15min & lunch time interaction

Background

- The Group's name is historical (23 years), but it has expanded to include:
- **Radar Systems**
  - Imaging Radar
  - Parasitic Radar
  - MIMO Radar (Networked Radar)
  - Tracking and Data Fusion
- **Image and Signal Processing** including cognition
- **Software Defined Radio / Radar**
- **Heterogeneous computing** in support of these activities
  - GPU, multicore, FPGA
  - Hardware and software

Why Research?

- Modern technology cannot be fully understood with less than a Masters degree: Ph.D. preferred.
- Without this insight, you will become a shuffler of paper (contracts) and hope your professional engineers know what product to recommend!
- The odds of innovating without this advanced knowledge are small.
- Satisfaction of working at the edge of technology, and the ability to make a difference.

What you learn is an art to innovate!

Radar

- Radar is the "Champaign of Electronics". It gives you exposure to:
    - An early appreciation of "Systems", a scarce skill;
    - Advanced mathematics;
    - RF and Microwaves;
    - Antennas;
    - High performance digital hardware;
    - Advanced software;
    - Remote sensing of the Environment: Radar is now one of the most important sensors in understanding the earth and planets;
    - Radio Astronomy: it is just half a radar....

VLSI

- Moore's laws
  - lots and lots of transistors
  - how to design --> EDA
  - how to test
  - design productivity gap
- Some avenues
  - soft IP
  - reconfigurable design
  - co-design
  - super computing and green computing
- Some challenges
  - how to make different parts talk
  - how to check that all works fine
  - how to make the design user friendly

High Performance Computing (HPC)

- What HPC?
  - 'Fast computing'
  - Processing big volumes data
  - Doing complex operations quickly
- Microprocessor-based multicore and clustered systems
- Parallel computing with GPUs
- FPGA and digital application accelerators
- Hybrid systems
  - CPU + GPU
  - CPU + GPU + FPGA

Software Defined Radio (SDR) Reconfigurable computer

- ● Examples of radio applications:
  - ○ Wireless router
  - ○ Cellular 3G transceiver
  - ○ FM radio
  - ○ Television
  - ○ Radar (e.g. speed sensor)
  - ○ A 'very large radar receiver' - radio astronomy

  Some benefits of reconf. computing:
  - ● Save time & cost for new systems
  - ● Upgrading infrastructure with more flexible hardware

HPC Work in the Group

- MeerKAT DSP grant
  - Support for RHINO platform development
  - Radio astronomy
  - Bioinformatics
  - RHINOradar

Active Radar Work in the Group

- Parasitic Radar, using FM Broadcast transmitters of opportunity as a low cost way of tracking air traffic.
- Networks of active radar sensors to improve radar performance, reduce EM spectral bandwidth usage, obviate "stealth" technology.
- Imaging Radar to measure surface subsidence due to mining and groundwater changes.
- Design of small imaging radars for airborne and spaceborne applications.
- New mathematical techniques for data tracking and smoothing.

Grand project 1: SAPAR

(South African Passive Radar)

- Flood with RF energy
- Every reflection embeds the reflector's signature
- Low cost solution for:
  - Air traffic
  - border security
  - disaster management
- Vision
  - Continent's indigenous technology
  - Cape-2-Cairo: single framework

Grand project 2: RHINO & TOKOLOSI

(Supercomputing and Green computing made affordable)

- RHINO
  - Platform to unleash the nation's innovations
  - Platform for proof of concept in almost every field
- TOKOLOSI
  - massively parallel computing
  - green and low cost
  - may hold the key to tomorrow's niche for the nation

Grand project 3: SARSat

(SA's space dominance over the continent)

- Satellite
  - existing expertise because of previous space prgram
  - a need for the continent
- RadarSAT
  - day night
  - all weather
  - security
  - disaster management
- RRSG: unique expertise in SAR in SA

M.Sc.(Eng.)

- Research
  - 180 Credits (1800 hours)
  - Full dissertation
- Research and Coursework
  - 120 Credit minor dissertation
  - 60 Credits of Coursework

Ph.D

- Must be registered for two Mays.
- Examined by a panel of three world experts.
- Requires a Masters.
- Can upgrade from a Masters programme (usually after a year). A good option to test a research idea.
- Requires originality in terms of contribution.
- These days, usually through the integration of advanced ideas from a number of fields.
- The supervisor is only an advisor and has no part in examination.

Research Masters M.Eng.(Radar)

- Mostly Coursework:
  - 120 Credits courses (6x20credits).
  - 60 Credit project.
- Some of the world's best subject experts.
- Advanced mathematics at the core.
- Courses taught intensive over a week, followed by 5 weeks of exercises and examination.
- Typically 16 months of work.

Funding Opportunities

Agency	Number	Eligibility	Topics
MeerKAT	3 Masters 1 Ph.D. 1 Postdoc	Any African	HPC, hardware and software in support of Radio Astronomy.
SANDF Project Ledger	Masters Ph.D.	South African residents	M.Eng.(Radar) All of current interests and support to RSA industry.
Radar Research Professorship	Masters Ph.D.	Open	All of current interests.
SA Space Agency Centre of Competence in Electo-optics	Masters Ph.D. Postdoc	Unclear	Imaging radar (Synthetic Aperture Radar)

Maximums, depending on merit: Ph.D. R120k pa, Masters R80k pa.
Travel to conferences.

NRF also offers research bursaries, mostly to South Africans. Early application required

Conclusions

- A research degree is essential for a long, creative career in engineering.
- The research of this group offers, through its international reputation, a world class training.
- Good funding available for the best students.