ICRAR & ICRAR-Pawsey Summer Studentships 2016 - 2017
Project Proposal

Project Details	
Project Title	Digital Noise, Accuracy and Precision
Primary Supervisor	Andreas Wicenec
Contact Details	andreas.wicenec@icrar.org
Additional Supervisors & Contact Details	Chen Wu (chen.wu@icrar.org)
Additional Resources Required	none
Student Location for project	UWA / ~~Curtin / Other~~
Project Description	This project aims to investigate and highlight the role and influence of digital noise, inaccurate representation of real numbers using **IEEE 754-2008** floating point representation and precision on scientific (and any other) calculations and compare that to representations using the novel UNUM approach (see John L. Gustafson. *The End of Error: Unum Computing*. CRC Press, 2015). One example highlighting this problem is the fact that IEEE 754 numbers, unlike real numbers, do not form an associative number space, i.e. in general the formula $(a + b) + c = a + (b + c)$ does ***not*** hold. The goal is to develop and document a few very clear use cases, highlighting the issues and then work on the implementation of those use cases using UNUMs. The use cases include one example from multi-scale calculations, one rounding error example and digital error analysis of the above. The project will provide deep understanding of the issues and limitations underlying the currently used number format in almost any standard CPU for scientific computing. We intend to use the results and material produced for future coursework as well as detailed analysis of the actual precision required performing the processing for the SKA.
Student Attributes	
Academic Background	Science, Computer Science, Applied Mathematics
Computing Skills	Programming in Python, C/C++ and/or Mathematica
Training Requirement	During the project IEEE754 and UNUMs. Some upfront reading would help.

Project Timeline	
Week 1	***See note below***
Week 2	Introduction to the project, background reading, first small example programs.
Week 3	Identification of science example use cases and writing of basic test code.
Week 4	Implementation of science use cases and error analysis
Week 5	***See note below***
Week 6	Implementation of science use cases and error analysis
Week 7	Implementation of science use cases in UNUM
Week 8	Comparative analysis
Week 9	Preparation of presentation and documentation of results
Week 10	***See note below***
	Final Presentation

NOTE: The first week as well as part of the last week and more than one additional week in the middle used to be unavailable during the last few years. This should be indicated in this form, because producing a 10 week project timeline, which then has to be finished within just 7 weeks is a pretty bad starting point. This is reflected in the timeline above. If the time should be available, we can easily extend the project and add more in depth analysis.