

SKA Activities in New Zealand

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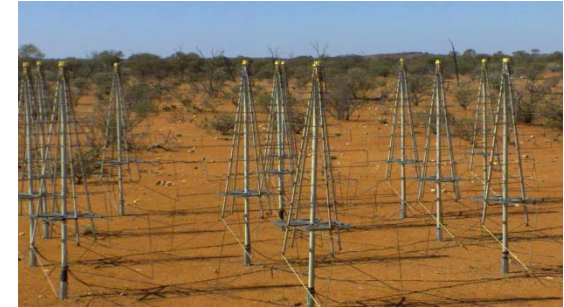
24/11/2015

- Square Kilometer Array
- SKA New Zealand Alliance
- Matlab Imaging Pipeline Model

SQUARE KILOMETER ARRAY

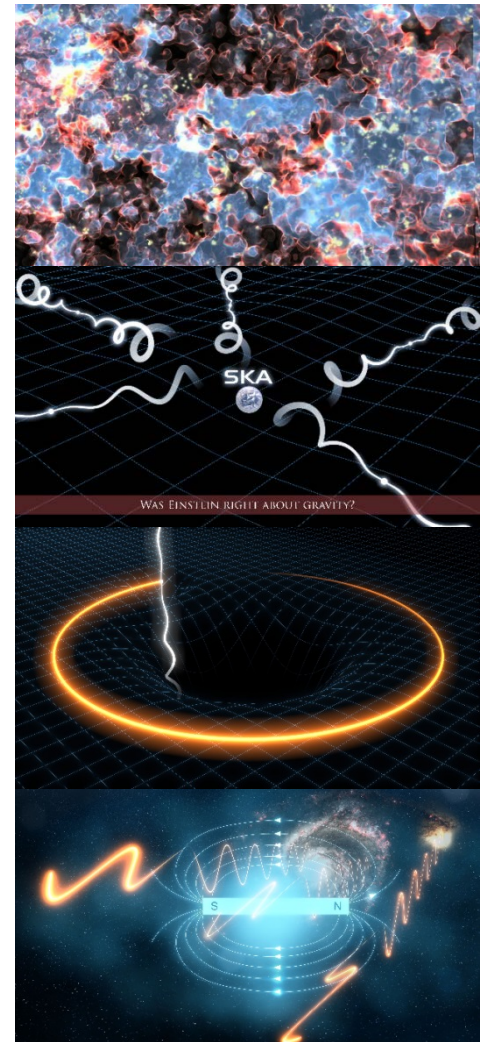
Square Kilometer Array

- Will be World's largest and most powerful radio telescope
- Actually four types of telescope arrays:
 - Low (sparse aperture array and later also dense aperture array)
 - Mid (single pixel dishes)
 - Survey (phased-array feed receivers)
- Cost €650M for SKA phase 1, estimated €2- €6billion for SKA phase 2
- Approximately 35-40% budget for computing hardware and software
- Preconstruction design for SKA1 commenced Nov 2013
- SKA1 design due to finish end 2016
- SKA1 construction 2018-2023



Square Kilometer Array

- Science cases:
 - Probing the Dark Ages and the Epoch of Reionization (tracking changes in Universe as first stars and galaxies formed)
 - Strong Field Tests of Gravity using Pulsars and Black Holes (high precision pulsar timing observations to test General Relativity)
 - Galaxy Evolution, Cosmology, and Dark Energy (track how galaxies accumulate gas and test properties of dark energy)
 - The Origin and Evolution of Cosmic Magnetism (track how cosmic magnetism has been generated)
 - The Cradle of Life (search for orbiting disks around stellar nurseries, prebiotic molecules)



Square Kilometer Array

- Correlator challenges
 - Exascale Big Data project (correlators will produce about 40 PB/hour)
 - Unprecedented I/O challenge (each telescope array requires up to 8 TB/s channelization and correlation and outputs up to 4 TB/s)
 - Green computing requirements
- Pulsar search challenges
 - 2000 beams instantaneous, each has 4000-15000 channels, sampled every 50 μ s for 7 min
 - Three-dimensional search (pulse period, dispersion, acceleration)
- Imaging challenges
 - Gridding and (inverse) FFT are enormous compute challenges
 - SDP estimated to require 80 PetaFLOP (sustained) for Mid in SKA1
 - Green computing requirements

SKA NZ ALLIANCE

SKA NZ Alliance

- AUT
 - HPCRL
 - IRASR
- Catalyst
- Compucon NZ
- Massey University
- Nyriad
- Open Parallel
- University of Auckland



Massey University

NYRIAD™



**THE UNIVERSITY
OF AUCKLAND**

More than 20 people in total
12 FTE dedicated to SKA

- NZ Alliance for SKA is focused on the IT part of SKA
- 3 partners are University (AUT, Massey, Auckland)
- All other members are IT companies
- Involved in two consortia for SKA
 - CSP (Central Signal Processing), which mainly includes correlators and pulsar search engine
 - SDP (Science Data Processor), which mainly includes imaging pipeline and post-processed data

SKA NZ Alliance



- Contributions – CSP
 - Lead work packages (costing, modeling, SDE, prototype,...)
 - Contributed to Mid and Low Correlators, and Pulsar search
 - Wrote the PowerMX SMC and AMC specifications
 - Project Management.
- Contributions – SDP
 - Contributed to Imaging Pipeline work package (PRD documentation, product tree)
 - Contributed to COMP work packages
 - Leading several prototype planning
 - Imaging Pipeline end-to-end model

MATLAB IMAGING PIPELINE MODEL

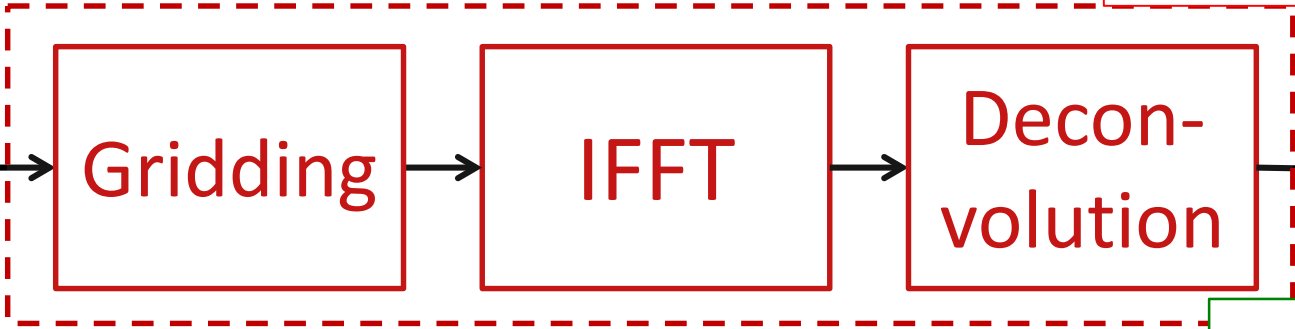
- The Imaging Pipeline of the SDP consortium delivers images from raw, correlated visibilities.
- SKA design choices such as deconvolution or gridding algorithms are still under study
- These design choices affects the computer requirement for SDP and, in the end, the final cost of the construction

- In order to study the various design possibilities, the High Performance Computing Research Lab (HPCRL) in AUT decided to create a model of the imaging pipeline
- One key result is the impact of single precision versus double precision in image and model accuracy
- Use of MATLAB: easy to change initial parameters, algorithm choices and precision analysis

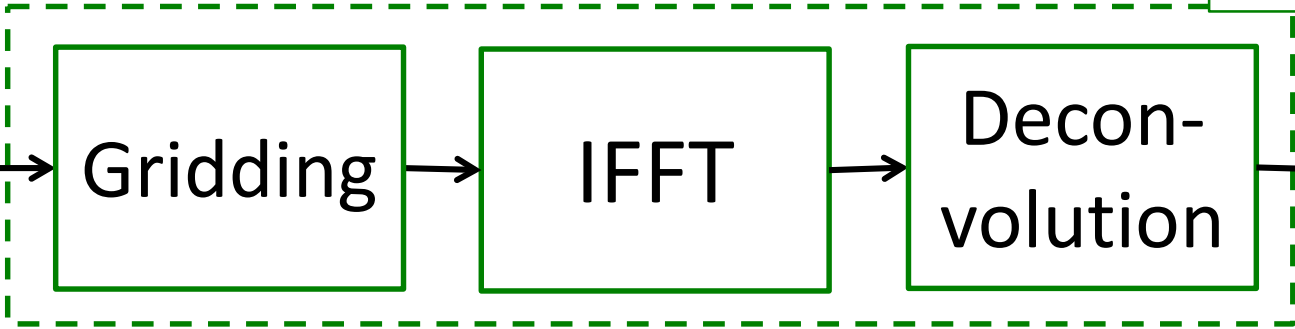
Matlab Imaging Pipeline Model

- Use ASKAPsoft as reference model
- Probes within ASKAPsoft for intermediate comparisons

ASKAPsoft



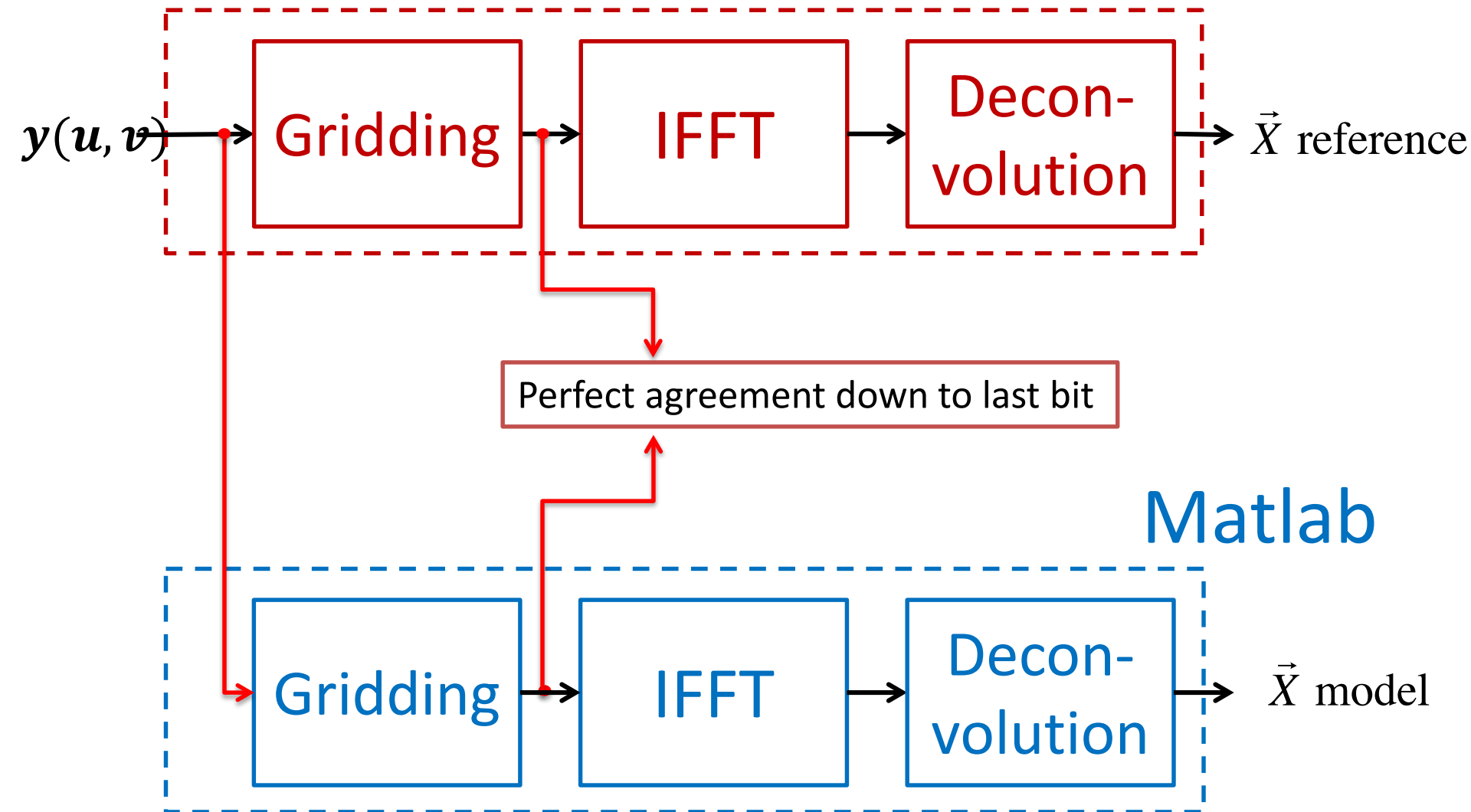
Matlab



SDP Imaging Pipeline Model

ASKAPsoft

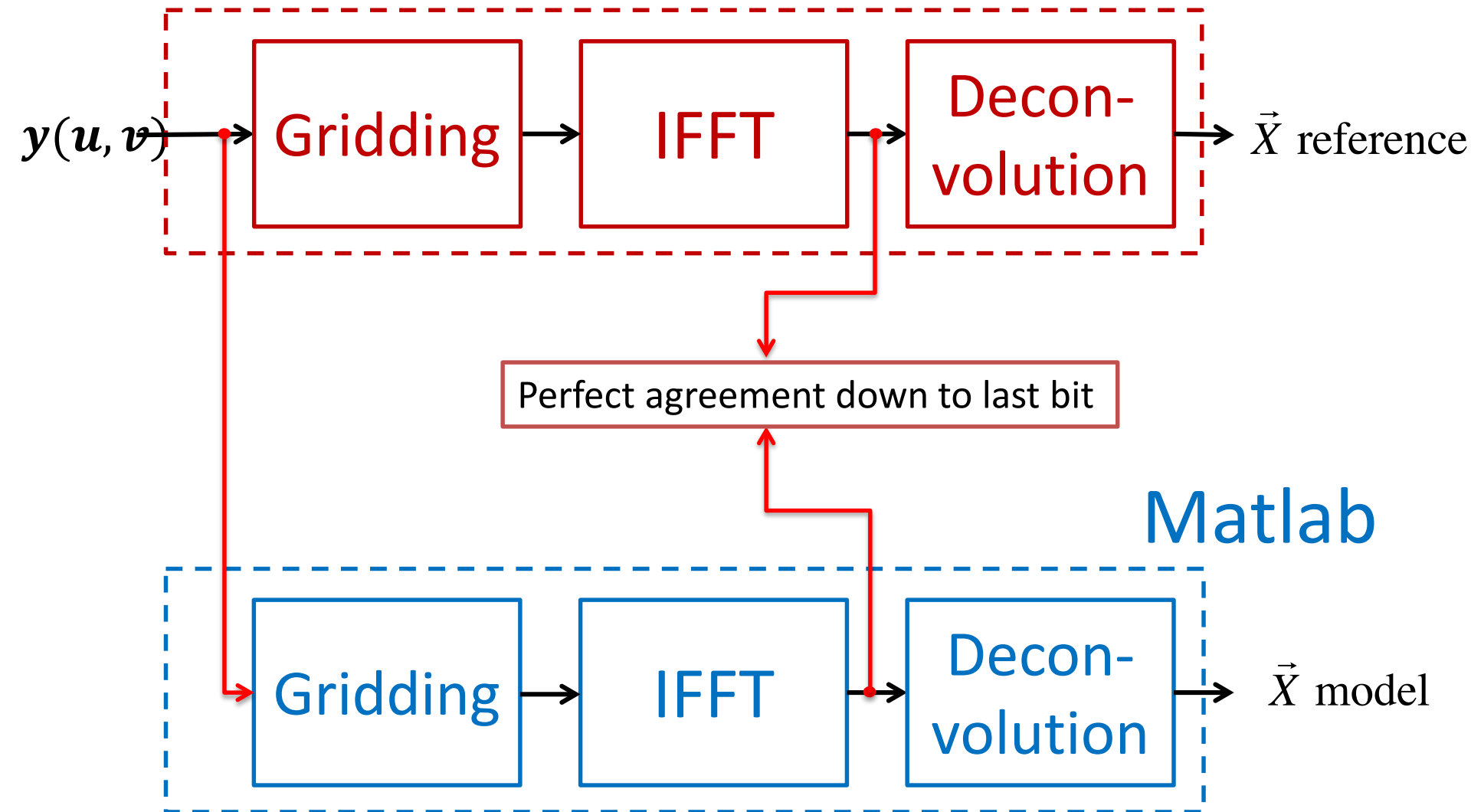
Matlab



SDP Imaging Pipeline Model

ASKAPsoft

Matlab



- Status:
 - Basic deconvolution tasks under development
 - Native MS reading in Matlab ongoing
 - Development slowed due to complexity of ASKAPsoft and visibility formats (MS)
- Future plans
 - Deliver first single versus double precision results
 - Complete basic SDP Imaging Pipeline Model

Summary

- New Zealand is a member of SKA organization
- NZ alliance for SKA is a important part of several SKA consortia (CSP, SDP)
 - More than 20 people and 12 FTE
- One contribution is an end-to-end Imaging Pipeline model
 - under development
 - Matlab based in order to easily test algorithms
 - Copy ASKAPsoft as a reference model