

The University of Manchester

Simulating interferometric data

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Overview

- "Toy" interferometers to get your head round things
- Simulating ALMA observations

Pynterferometer

http://www.jb.man.ac.uk/pynterferometer/



APSYNSIM

http://www.nordic-alma.se/support/software-tools



Have a go with a toy interferometer

http://www.jb.man.ac.uk/~aavison/ESO_javascript/gridIndex.html

More rigourous simulations

THE OST	CASA
 Introduction to the OST Hands on with the OST OST Inputs OST Output 	 simobserve simanalyse Simalma

The Observation Support Tool

ALMA Regional Centre UK	ALMA Observation Support Tool				
Version 3.0					
OST NEWS HELP QUEUE LIBRARY ALMA	HELPDESK				
US1 Report: US1 usage statistics during the ALMA Cycle 3 Call.					
Instrument: ALMA	Select the desired ALMA antenna configuration.				
sky Setup:					
Source model: OST Library: Central point source	Choose a library source model or supply your own.				
Upload: Browse No file selected.	You may upload your own model here (max 10MB).				
Declination: -35400m00.0s Image peak / point flux in mJy 3 0.0	Ensure correct formatting of this string (+/-00d00m00.0s). Rescale the image data with respect to new peak value. Set to 0.0 for no rescaling of source model.				
Observation Setup:					
Observing mode: O Spectral O Continuum	Spectral or continuum observations?				
Central frequency in GHz: 260.7	The value entered must be within an ALMA band.				
Bandwidth in GHz : 4.125 OK	Select the total bandwidth for continuum observations. Enter 7.5 GHz to select ALMA recommend full continuum setup.				
SPW 0: 254.0 BW 0: 1.875	Set the central frequency and bandwidth of each baseband/SPW in GHz.				
SPW 1: 252.0 BW 1: 1.5	SPWs can only be placed within the grey shaded areas.				
SPW 2: 267.0 BW 2: 0.75	They will be truncated in the simulation if not. More SPWs (up to SPW3) will become available as you increase the total				
SPW 3: 0.0 BW 3: 0.0	bandwidth.				
Band = 6					

A web-based ALMA simulator aimed at the non-interferometry expert user.

The primary version is for ALMA and has been available since ALMA Cycle 0 CfP. Since when it has been extensively used by the international community in all ALMA call for proposals.

See

http://almaost.jb.man.ac.uk

There are also eMerlin and an AVN* version.

<u>http://almaost.jb.man.ac.uk/emerlin</u> <u>http://almaost.jb.man.ac.uk/AVN</u>

* For a hypothetical AVN telescope



Simulating with CASA

Simobserve

simobserve is used to create the simulated interferometric observations within CASA and **simanalyze** is used to analyze the output of **simobserve** (suprise suprise).

Creating simulations in CASA, a recipe:

- First select an existing image of the region or type of object you want to simulate, for use as your **skymodel**.
- Your input sky model can then be rescaled in pixel size, brightness, sky position, central frequency and channel width with e.g. incell
- The setpointings and observe parameters are then used to define the simulated observation, with similar parameters to defining real observations.
- The corruption due to the atmosphere can then be set in **thermalnoise**.
- With antennalist you can define which telescope you are using. CASA knows a lot... eMerlin, ALMA, VLA, ATCA, PdBI, EVN, etc etc.

CASA < 1>: inp simo > inp(simo)	bse bse	rve rve)		
<pre># simobserve :: v</pre>	isi	bility simulation	tas	k
project	=	'sim'	#	root prefix for output file names
skymodel	=		#	model image to observe
complist	=	• • • •	#	componentlist to observe
setpointings	=	True		
integration	=	'10s'	#	integration (sampling) time
direction			#	"J2000 19h00m00 -40d00m00" or "" to
			#	center on model
mapsize		['', '']	#	angular size of map or "" to cover
			#	model
maptype		'ALMA'	#	hexagonal, square (raster), ALMA, etc
pointingspaci	ng :	- · · · · ·	#	spacing in between pointings or
			#	"0.25PB" or "" for ALMA default
			#	INT=lambda/D/sqrt(3), SD=lambda/D/3
obsmode	=	'int'	#	observation mode to simulate [int(int
			#	erferometer) sd(singledish) ""(none)
			#]
antennalist		'alma.out10.cfg'	#	interferometer antenna position file
refdate		'2014/05/21'	#	date of observation – not critical
			#	unless concatting simulations
hourangle		'transit'	#	hour angle of observation center e.g.
			#	"-3:00:00", "5h", "-4.5" (a number
			#	without units will be interpreted as
			#	hours), or "transit"
totaltime		'7200s'	#	total time of observation or number
			#	of repetitions
caldirection			#	pt source calibrator [experimental]
calflux		'1Jy'		
outframe	=	'LSRK'	#	spectral frame of MS to create
thermalnoise	=	'tsys-atm'	#	add thermal noise: [tsys-atm tsys-
			#	manual ""]
user_pwv		0.5	#	Precipitable Water Vapor in mm
t_ground		269.0	#	ambient temperature
seed		11111	#	random number seed
leakage	=	0.0	#	cross polarization (interferometer
			#	only)
raphics	=	'both'	#	display graphics at each stage to
			#	[screen file both none]
verbose	=	False		
overwrite	=	True	#	overwrite files starting with
			#	\$project

Simanalyze

Here we convert the CASA MS into an image file.

- The **image** parameter effectively ٠ acts like CLEANing a real dataset with iteration, weighting etc
- Next the analyze parameter ٠ defines which output images you would like from your analysis. Such as Clean image, UV coverage and image

CAS	\ <2>: inp si m	analy	ze		
	> 1np(s1m	iana Ly:	ze)		
F S	simanalyze ::	image	and analyze	measure	ment sets created with simobserve
oro_	ject	_	True	#	(re) impact the reliant the reliant
lmag	je	=	True	#	(re)image sproject.*.ms to
	vie		Idefault!	#	Approject.image
	wis modelimage		11	#	lower resolution prior image
	moderimage			# #	in clean e.g. existing total power image
	imsize		0	# #	output image size in pixels (x,y) or 0 to match model
	imdirection			# #	set output image direction, (otherwise center on the model)
	cell			# #	cell size with units e.g. "10arcsec" or "" to equal model
	interactive		False	# #	<pre>interactive clean? (make sure to set niter>0 also)</pre>
	niter		0	# #	<pre>maximum number of iterations (0 for dirty image)</pre>
	threshold		'0.1mJy'	#	flux level (+units) to stop cleaning
	weighting		'natural'	# #	weighting to apply to visibilities. briggs will use robust=0.5
	mask		П	# #	Cleanbox(es), mask image(s), region(s), or a level
	outertaper		D	# #	uv-taper on outer baselines in uv- plane
	pbcor		True	# #	correct the output of synthesis images for primary beam response?
	stokes		'1'	#	Stokes params to image
	featherimage			#	image (e.g. total power) to feather
				#	with new image
anal	lyze	=	False	# #	<pre>(only first 6 selected outputs will be displayed)</pre>
grap	ohics	=	'both'	# #	<pre>display graphics at each stage to [screen file both none]</pre>
/ert	ose	=	False		
over	rwrite	=	True	# #	overwrite files starting with \$project
iryı	run	=	False	# #	<pre>only print information [experimental; only for interfermetric data]</pre>
logi	file	=			

Simalma

• A wrapper of simobserve and simanalyze which has some of these tasks parameters set to typical ALMA values.