1.4.19 vpmanager - Tool

Package synthesis
Module imager

Tool for specifying voltage patterns and primary beams
include "vpmanager.g"

Description
The vpmanager, or voltage pattern manager, creates a table with the description of one or more voltage patterns (vp) or primary beams (pb). There is a mapping between telescope name and the vp or pb description. The vp description table can be read by imager's setvp method, which instantiates the corresponding voltage patterns from the descriptions and applies them to the images. While the vp description table can have multiple telescopes in it, limitations to the internal visibility buffers currently limit the functionality within imager to a single telescope.

What vpmanager does:

Set a Given Telescope's VP/PB model The vpmanager recognizes the names of several telescopes: ATCA, GBT, GMRT, HATCREEK, NMA, NRAO12M, NRAO140FT, OVRO, VLA, WSRT. New telescopes and their default VP/PB models will need to be added to the system.

Common VP/PB Models Many common voltage pattern (vp) and primary beam (pb) models have been coded into AIPS++. Currently, the recognized models include DEFAULT, ATCA_L1, ATCA_L2, ATCA_L3, ATCA_S, ATCA_C, ATCA_X, GBT, GMRT, HATCREEK, NRAO12M, NRAO140FT, OVRO, VLA, VLA_INVERSE, VLA_NVSS, VLA_2NULL, VLA_4, VLA_P, VLA_L, VLA_C, VLA_X, VLA_U, VLA_K, VLA_Q, WSRT, and WSRT_LOW. In all cases, the VP/PB model and the beam squint (if present) scale linearly with wavelength. If DEFAULT is selected, the approrpiate VP/PB model is selected for the telescope and observing frequency.

1-D Beam Models Most beam models are rotationally symmetric (excepting beam squint). From the beam parameterization in terms of the various coefficients and other terms, an internal lookup table with 10000 elements is created for application of the VP/PB to an image.

Beam Squint The VP/PB models include beam squint. The VLA_L, VLA_C, VLA_X, VLA_U, VLA_K, and VLA_Q models (which are the defaults for those VLA bands), have the appropriate squint magnitude and orientation, though the orientation has not been verified through processing actual data.

Multiple VP/PB Models for one MS The VPManager can have VP information for multiple telescopes. However, the internals of imager cannot yet deal with VP/PB's for multiple telescopes. In the case of a MS with multiple telescopes present, the primary beam of the first telescope present in the MS will be used, even if it is not the first telescope specified in the VP description table produced by vpmanager.

Antenna-dependent Voltage Patterns are not yet supported.

Two-dimensional Voltage Pattern Images are supported via setpbimage.

Example
The following example shows a simple way to make a new voltage pattern table.
Note that this can be more easily done from the toolmanager.

```
include 'vpmanager.g'
#
# make the vpmanager
#
algore := vpmanager();
#
# Lets say we want an Airy Disk voltage pattern for our
# HATCREEK data, but we want to use the system default
# for the OVRO data:
#
algore.setpbairy(telescope='HATCREEK', dopb=T, dishdiam='6.0m', blockagediam='0.6m',
  maxrad='2arcmin', reffreq='100GHz', dosquint=F);
#
algore.setcannedpb(telescope='OVRO', dopb=T, commonpb='DEFAULT', dpsquint=F);
#
algore.summarizevps();
#
algore.saveastable(tablename='California.Beaming');
#
```

Constructors

vpmanager	Construct a vpmanager tool

Functions

done	Terminate the vpmanager
saveastable	Save the vp or pb descriptions as a table
setcannedpb	Select a vp/pb from our library of common pb models
setpbairy	Make an airy disk vp
setpbcospoly	Make a vp/pb from a polynomial of scaled cosines
setpbgauss	Make a Gaussian vp/pb
setpbimage	Make a vp/pb from a user-supplied image
setpbinvpoly	Make a vp/pb as an inverse polynomial
setpbnumeric	Make a vp/pb from a user-supplied vector
setpbpoly	Make a vp/pb from a polynomial
summarizevps	Summarize the currently accumulated VP descriptions

vpmanager - Constructor

Package	synthesis
Module	imager
Tool	vpmanager

Construct a vpmanager tool

Synopsis
vpmanager()

Description
The vpmanager constructor has no arguments.

---

vpmanager.saveastable - Function

Package	synthesis
Module	imager
Tool	vpmanager

Save the vp or pb descriptions as a table

Synopsis
saveastable(tablename)

Description

Save the vp or pb descriptions as a table. Each description is in a different row of the table.

Arguments

tablename	Name of table to save vp descriptions in AllowedString

---

vpmanager.summarizevps - Function

Package	synthesis
Module	imager
Tool	vpmanager

Summarize the currently accumulated VP descriptions

Synopsis
summarizevps(verbose)

Description
Summarize the currently accumulated VP descriptions to the logger.

Arguments

verbose	Print out full record? Otherwise, print summary. AllowedBool DefaultT

---

vpmanager.done - Function

Package	synthesis
Module	imager
Tool	vpmanager

Terminate the vpmanager

Synopsis
done()

Description
Eliminate the current vpmanager.

Returns
Bool

---

vpmanager.setcannedpb - Function

Package	synthesis
Module	imager
Tool	vpmanager

Select a vp/pb from our library of common pb models

Synopsis
setcannedpb(telescope, othertelescope, dopb, commonpb, dosquint, paincrement, usesymmetricbeam)

Description
We have many vp/pb models ready to go for a variety of telescopes. If 'DEFAULT' is selected, the system default for that telescope and frequency is used.

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed String
othertelescope	If telescope=="OTHER", specify name here Allowed String
dopb	Should we apply the vp/pb to this telescope's data? Allowed Bool Default T
commonpb	List of common vp/pb models: DEFAULT code figures it out Allowed String Default DEFAULT
dosquint	Enable the natural beam squint found in the common vp model Allowed Bool Default F
paincrement	Increment in Parallactic Angle for asymmetric (ie, squinted) vp application Allowed Quantity Default 360deg
usesymmetricbeam	Not currently used Allowed Bool Default F

Returns
itemcontainer

---

vpmanager.setpbairy - Function

Package	synthesis
Module	imager
Tool	vpmanager

Make an airy disk vp

Synopsis
setpbairy(telescope, othertelescope, dopb, dishdiam, blockagediam, maxrad, reffreq, squintdir, squintreffreq, dosquint, paincrement, usesymmetricbeam)

Description
Information sufficient to create a portion of the Airy disk

voltage pattern. The Airy disk pattern is formed by Fourier transforming a uniformly illuminated aperture and is given by

$$vp_p(i) = (areaRatio*2.0*j_1(x)/x - 2.0*j_1(x*lengthRatio)/(x*lengthRatio))/areaNorm, \tag{1.18}$$

where areaRatio is the dish area divided by the blockage area, lengthRatio is the dish diameter divided by the blockage diameter, and

$$x = \frac{i*maxrad*7.016*dishdiam/24.5m}{N_{samples}*1.566*60}. \tag{1.19}$$

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed String
othertelescope	If telescope=="OTHER", specify name here Allowed String
dopb	Should we apply the vp/pb to this telescope's data? Allowed Bool Default T
dishdiam	Effective diameter of dish Allowed Quantity Default 25m
blockagediam	Effective diameter of subreflector blockage Allowed Quantity Default 2.5m
maxrad	Maximum radial extent of the vp/pb (scales with 1/freq) Allowed Quantity Default 0.8deg
reffreq	Frequency at which maxrad is specified Allowed Quantity Default 1GHz
squintdir	Offset of RR beam from pointing center, azel frame (scales with 1/freq) Allowed Measure Default Measure
squintreffreq	Frequency at which the squint is specified Allowed Quantity Default 1GHz
dosquint	Enable the natural beam squint found in the common vp model Allowed Bool Default F
paincrement	Increment in Parallactic Angle for asymmetric (ie, squinted) vp application Allowed Quantity Default 360deg
usesymmetricbeam	Not currently used Allowed Bool Default F

Returns
itemcontainer

---

vpmanager.setpbcospoly - Function

Package	synthesis
Module	imager
Tool	vpmanager

Make a vp/pb from a polynomial of scaled cosines

Synopsis

setpbcospoly(telescope, othertelescope, dopb, coeff, scale, maxrad, reffreq, isthispb, squintdir, squintreffreq, dosquint, paincrement, usesymmetricbeam)

Description

A voltage pattern or primary beam of the form

$$VP(x) = \sum_i (coeff_i \cos^{2i}(scale_i x). \tag{1.20}$$

This is a generalization of the WSRT primary beam model.

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed String
othertelescope	If telescope=="OTHER", specify name here Allowed String
dopb	Should we apply the vp/pb to this telescope's data? Allowed Bool Default T
coeff	Vector of coefficients of cosines Allowed Vector of Double Default 0
scale	Vector of scale factors of cosines Allowed Vector od Doubles Default 0
maxrad	Maximum radial extent of the vp/pb (scales with 1/freq) Allowed Quantity Default 0.8deg
reffreq	Frequency at which maxrad is specified Allowed Quantity Default 1GHz
isthispb	Do these parameters describe a PB or a VP? Allowed String: 'PB'|'VP'
squintdir	Offset of RR beam from pointing center, azel frame (scales with 1/freq) Allowed Measure Default Measure
squintreffreq	Frequency at which the squint is specified Allowed Quantity Default 1GHz
dosquint	Enable the natural beam squint found in the common vp model Allowed Bool Default F
paincrement	Increment in Parallactic Angle for asymmetric (ie, squinted) vp application Allowed Quantity Default 360deg
usesymmetricbeam	Not currently used Allowed Bool Default F

Returns
itemcontainer

vpmanager.setpbgauss - Function

Package	synthesis
Module	imager
Tool	vpmanager

Make a Gaussian vp/pb

Synopsis
setpbgauss(telescope, othertelescope, dopb, halfwidth, maxrad, reffreq, isthispb, squintdir, squintreffreq, dosquint, paincrement, usesymmetricbeam)

Description
Make a Gaussian primary beam given by

$$PB(x) = e^{-(x/(halfwidth*\sqrt{1/\log(2)}))}. \quad (1.21)$$

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed String
othertelescope	If telescope=="OTHER", specify name here Allowed String
dopb	Should we apply the vp/pb to this telescope's data? Allowed Bool Default T
halfwidth	Half power half width of the Gaussian at the reffreq Allowed Quantity Default 0.5deg
maxrad	Maximum radial extent of the vp/pb (scales with 1/freq) Allowed Quantity Default 0.8deg
reffreq	Frequency at which maxrad is specified Allowed Quantity Default 1GHz
isthispb	Do these parameters describe a PB or a VP? Allowed String: 'PB'|'VP'
squintdir	Offset of RR beam from pointing center, azel frame (scales with 1/freq) Allowed Measure Default Measure
squintreffreq	Frequency at which the squint is specified Allowed Quantity Default 1GHz
dosquint	Enable the natural beam squint found in the common vp model Allowed Bool Default F
paincrement	Increment in Parallactic Angle for asymmetric (ie, squinted) vp application Allowed Quantity Default 360deg
usesymmetricbeam	Not currently used Allowed Bool Default F

Returns
itemcontainer

---

vpmanager.setpbinvpoly - Function

Package synthesis
Module imager
Tool vpmanager

Make a vp/pb as an inverse polynomial

Synopsis
setpbinvpoly(telescope, othertelescope, dopb, coeff, maxrad, reffreq, isthispb, squintdir, squintreffreq, dosquint, paincrement, usesymmetricbeam)

Description
The inverse polynomial describes the inverse of the VP or PB as a polynomial of even powers:

$$1/VP(x) = \sum_i coeff_i * x^{2i}. \tag{1.22}$$

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed: String
othertelescope	If telescope=="OTHER", specify name here Allowed: String
dopb	Should we apply the vp/pb to this telescope's data? Allowed: Bool Default: T
coeff	Coefficients of even powered terms Allowed: Vector of Doubles Default: [0]
maxrad	Maximum radial extent of the vp/pb (scales with 1/freq) Allowed: Quantity Default: 0.8deg
reffreq	Frequency at which maxrad is specified Allowed: Quantity Default: 1GHz
isthispb	Do these parameters describe a PB or a VP? Allowed: String: 'PB'|'VP'
squintdir	Offset of RR beam from pointing center, azel frame (scales with 1/freq) Allowed: Measure Default: Measure
squintreffreq	Frequency at which the squint is specified Allowed: Quantity Default: 1GHz
dosquint	Enable the natural beam squint found in the common vp model Allowed: Bool Default: F
paincrement	Increment in Parallactic Angle for asymmetric (ie, squinted) vp application Allowed: Quantity Default: 360deg
usesymmetricbeam	Not currently used Allowed: Bool Default: F

Returns
itemcontainer

---

vpmanager.setpbnumeric - Function

Package synthesis

Module imager
Tool vpmanager

Make a vp/pb from a user-supplied vector

Synopsis
setpbnumeric(telescope, othertelescope, dopb, vect, maxrad, reffreq, isthispb, squintdir, squintreffreq, dosquint, paincrement, usesymmetricbeam)

Description
Supply a vector of vp/pb sample values taken on a regular grid between x=0 and x=maxrad. We perform sinc interpolation to fill in the lookup table.

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed String
othertelescope	If telescope=="OTHER", specify name here Allowed String
dopb	Should we apply the vp/pb to this telescope's data? Allowed Bool Default T
vect	Vector of vp/pb samples uniformly spaced from 0 to maxrad Allowed Vector of Doubles Default 0
maxrad	Maximum radial extent of the vp/pb (scales with 1/freq) Allowed Quantity Default 0.8deg
reffreq	Frequency at which maxrad is specified Allowed Quantity Default 1GHz
isthispb	Do these parameters describe a PB or a VP? Allowed String: 'PB'|'VP'
squintdir	Offset of RR beam from pointing center, azel frame (scales with 1/freq) Allowed Measure Default Measure
squintreffreq	Frequency at which the squint is specified Allowed Quantity Default 1GHz
dosquint	Enable the natural beam squint found in the common vp model Allowed Bool Default F
paincrement	Increment in Parallactic Angle for asymmetric (ie, squinted) vp application Allowed Quantity Default 360deg
usesymmetricbeam	Not currently used Allowed Bool Default F

Returns
itemcontainer

---

vpmanager.setpbimage - Function

Package	synthesis
Module	imager
Tool	vpmanager

Make a vp/pb from a user-supplied image

Synopsis

setpbimage(telescope, othertelescope, dopb, realimage, imagimage)

Description

Experimental: Supply an image of the E Jones elements. The format of the image is:

Shape nx by ny by 4 complex polarizations (RR, RL, LR, LL or XX, XY, YX, YY) by 1 channel.

Direction coordinate Az, El

Stokes coordinate All four ''stokes'' parameters must be present in the sequence RR, RL, LR, LL or XX, XY, YX, YY.

Frequency Only one channel is currently needed - frequency dependence beyond that is ignored.

One or two images may be specified - the real (must be present) and imaginary parts (optional).
Note that beamsquint must be intrinsic to the images themselves. This will be accounted for correctly by regridding of the images from Az-El to Ra-Dec according to the parallactic angle.

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed:String
othertelescope	If telescope=="OTHER", specify name here Allowed:String
dopb	Should we apply the vp/pb to this telescope's data? Allowed:Bool Default:T
realimage	Real part of vp as an image Allowed:String Default:''''
imagimage	Imaginary part of vp as an image Allowed:String Default:''''

Returns
itemcontainer

---

vpmanager.setpbpoly - Function

Package	synthesis
Module	imager
Tool	vpmanager

Make a vp/pb from a polynomial

Synopsis
setpbpoly(telescope, othertelescope, dopb, coeff, maxrad, reffreq, isthispb, squintdir, squintreffreq, dosquint, paincrement, usesymmetricbeam)

Description
The VP or PB is described as a polynomial of even powers:

$$VP(x) = \sum_i coeff_i * x^{2i}. \tag{1.23}$$

Arguments

telescope	Which telescope in the MS will use this vp/pb? Allowed String
othertelescope	If telescope=="OTHER", specify name here Allowed String
dopb	Should we apply the vp/pb to this telescope's data? Allowed Bool Default T
coeff	Coefficients of even powered terms Allowed Vector of Doubles Default 0
maxrad	Maximum radial extent of the vp/pb (scales with 1/freq) Allowed Quantity Default 0.8deg
reffreq	Frequency at which maxrad is specified Allowed Quantity Default 1GHz
isthispb	Do these parameters describe a PB or a VP? Allowed String: 'PB'|'VP'
squintdir	Offset of RR beam from pointing center, azel frame (scales with 1/freq) Allowed Measure Default Measure
squintreffreq	Frequency at which the squint is specified Allowed Quantity Default 1GHz
dosquint	Enable the natural beam squint found in the common vp model Allowed Bool Default F
paincrement	Increment in Parallactic Angle for asymmetric (ie, squinted) vp application Allowed Quantity Default 360deg
usesymmetricbeam	Not currently used Allowed Bool Default F

Returns
itemcontainer