

rcf

keys:	[from]	<code><number></code>	first source picture
	[to]	<code><number></code>	output picture
	with	<code><number></code>	second source picture
	over	<code><number></code>	width in pixels of bands of Fourier components compared at each spatial frequency
	radius	<code><number></code>	radius of real-space mask applied to compared images; affects significance threshold only
options:	phaseresidual		produce phase-residual instead of radial correlation function

rcf performs a *radial correlation function* on an image. You use **rcf** to assess the useful resolution of an image of which you have two copies with independent noise, by tabulating how well their Fourier components agree at different spatial frequencies. You can choose either cross-correlation coefficients or phase-residual values.

Examples

```
rcf 1 with 2 to 3; display times 4
```

This command displays the *radial correlation function* between transforms 1 and 2, with a significance threshold curve superposed.

```
rcf 1 with 2 phaseresidual over 3
```

This command puts in picture 999 the *phase residual function* between transforms 1 and 2, calculated over bands 3 pixels wide.

```
for n=1,2; mask n radius 45 width 5; fourier; loop
rcf 1 with 2
```

This sequence of commands generates the *rcf* for two *Images*, including the smooth-edged masks necessary to prevent spurious high frequency mismatches.

Description

You must specify two source pictures with the **rcf** command, using the keys **from** and **with**. These source pictures must be half-plane Fourier transforms of square pictures.

Semper 6 Command Reference

rcf

rcf produces 1-D output, with zero spatial frequency at the left (the origin) and maximum spatial frequency (0.5/pixel) at the right. You can apply two types of function using the **rcf** command:

- radial correlation function
- phase-residual function

The *radial correlation* values, generated by default, are standard cross-correlation coefficients between corresponding (complex) Fourier components, normalised to lie in the range -1 to 1 .

The *phase-residual* values are the *rms* phase difference (in radians) between corresponding Fourier components, with the differences weighted in proportion to the sum of the two relevant moduli. Use the **phaseresidual** option to generate phase-residual values.

By default, the Fourier components of each picture are grouped into bands that are one pixel wide. Use the **over** key to specify a greater width, as in the second command example, where wider overlapping bands are used, which effectively smooth the output.

You can use a smooth-edged mask, as in the last command example, to make both images fade out smoothly towards the picture edges beyond the features of interest before using **rcf**. This prevents opposite-edge mismatches or sharp features at mask edges from generating artificially raised high-frequency agreement.

The output of the **rcf** command has two layers. The second layer contains a *limiting significance threshold* curve to assist assessment of the first layer. (Use the command **display layer 1** to see the *rcf* only, without the significance threshold superposed). For the cross-correlation mode, the threshold is $2/\sqrt{n}$ where n is the number of independent Fourier components in the relevant band. Where correlation levels are low, this is twice the expected standard deviation of the correlation values. For the *phase-residual* mode, it is simply a constant value of $\pi/4$ – a less optimistic threshold corresponding to a correlation level of 0.71.

If the original images are severely masked off, the number of independent Fourier components is reduced, and **rcf** adjusts the significance threshold curve appropriately, if you tell it the mask **radius** (for example, **rcf 1 with 2 radius 45** in the last command example).

Notes

multi-layer pictures:	faulted
forms use internally:	complex
see also:	fourier, mask

Defaults and Ranges

keys/options	defaults	range
[from]	current picture, held in variable <i>select</i>	valid picture number
[to]	picture 999	valid picture number
with	<i>none</i>	valid picture number
over	width 1	positive integer
radius	infinite	positive integer
phaseresidual	produce <i>radial correlation function</i>	