Pre-Jitter Studies

Things you need to know before you use Jitter.

About computer graphics

You probably know the screen is comprised of millions of tiny dots called pixels. Each pixel has three parts (visible with a strong magnifying glass): Red, Green and Blue, which combine to give the appearance of subtly shaded colors. The pixels on computer screens are square, but the pixels in DV cameras are slightly narrowed (or stretched for PAL), which requires some fiddling in the conversion. The intensity of each part of the pixel is controlled by an eight bit number[1], so twentyfour bits determine the color.

Traditional (NTSC) TV sets have 525 scan lines, but 39 don't show, leaving 486 visible on the screen. The horizontal resolution varies with the tube, but is measured as if there were vertical lines. A good TV will have a horizontal resolution of 648, showing the same amount of detail left to right as top to bottom. HD TV is either 1280 by 720 or 1920 by 1080. Computer monitor resolutions go up with each model, but we pick the resolution in use based on how fine print appears. Choosing higher resolutions shows more picture rather than better picture. For a given video display adapter (video card) you get a list to choose from. Sometimes you will see certain choices recommended. These are the ones that look best given the actual number of pixels on the monitor. If you have a screen with 1024 pixels across, you can easily show 512 by 384 just by lighting up four pixels on the screen for each one in the image. But to show 640 by 480, some kind of fudging is required. This is done by resampling the image, which may give artifacts like unevenly spaced lines or jagged diagonals.

The shape of a screen is called aspect ratio and measures width to height. Movie aspect ratios range from 1.33:1 (or 4:3) for old standard to 2.35:1 for widescreen. Standard TV is 1.33:1 and HDTV is 16:9. Still photographs are also commonly 1.33:1 and 16:9.

The motion in motion pictures comes from projecting a new image or frame 24 times a second. In American TV the images are changed approximately 30 times a second. The eye perceives smooth motion at these rates, but going slower than 20 frames per second will produce flicker. Many computer monitors run 70 frames a second or faster. TVs actually update 60 times per second, but are only showing half the picture at that rate. They paint the even lines on one pass and the odd lines on the second pass, a process called interlacing. A screen that does not interlace is called progressive scan. Interlacing is often indicated by a letter after the vertical resolution-- 720i or 720p.

Images are typically stored (or synthesized) in one of two ways. There may be a list of the color values for each pixel in the image. This is often called a "bitmap" from the black and white days when a pixel was on or off. The more accurate "pixelmap" never caught on. This huge list (921,600 bytes for standard resolution) is usually organized as an array of 640 x 480 x 3 bytes to make the address of the bytes easily related to their

[1] An eight bit number is called a byte or char.

location on the screen. In Jitter, a video image is stored in a 2 dimensional matrix that has four "planes". This gives a cell for each pixel location (Horizontal, Vertical) with bytes for red, green, and blue as well as a fourth for opacity. Opacity is called alpha and can be manipulated when images are combined.

The other common way of storing an image is to give instructions for drawing it. This requires much less data storage, especially if the image is pretty much the same from frame to frame. The format for such instructions is rather like a connect-the-dots drawing. Points are specified that represent the corners or vertices of a shape, and the shape is filled in with a specified color. This can easily be done in 3D by using 3 numbers to specify each vertex. Three vertices determine a triangular facet, and the facets can be assembled into an object of any complexity. One of the beauties of this system is that moving or rotating the object requires changing only a few numbers. Of course such an image must be converted (rendered) to pixel values for display on the screen. This is a lot of computing, but most video cards contain a dedicated microprocessor (3D accelerator) to do it. There is a standardized format for drawing instructions called openGL, which Jitter understands.

The bitmap approach to graphics is called raster imaging, and the drawing instructions approach is called a vector image. As general rule, we use raster techniques to process video from live sources and do animation with vectors. It's easy to convert a vector image to a raster, so both kinds can be combined in the final result. There's no easy way to convert a video image to a vector image, but a bitmap can be applied as a texture to a vector surface.

Some colorful terms defined

Luminance is the intensity of a video image or pixel. It's the sum of the R G and B values, weighted for the different sensitivity of the eye to those colors. Luma is similar, but calculated including Gamma Correction which compensates for the nonlinear response of screen pigments and other electrical components in the system. Brightness is the average of the R G and B values. In broadcast TV, luminance is the black and white information of the picture.

Contrast is the ratio of the luminance of the brightest parts of an image to the darkest.

Chrominance or Chroma is the color information signal of broadcast TV. It is actually the difference between the color of a pixel and a reference color (dark green). The actual way this is done varies around the world, but the pertinent fact is that if chroma is 0, there is no color. In jitter, chroma of 1 is the natural color. The European broadcast TV system is often called YUV encoding (as opposed to YIQ for American system). Luminance is Y and chrominance supplies the UV (or IQ) part.

Color space is a method for describing the colors available in a system as well as the method of encoding color. RGB and YUV are examples, but there are many others, including CYMK used for printing and commercial systems like Pantone. Many systems illustrate color space with a color wheel or some three dimensional variant. HSV (Hue, Saturation, Value) for instance is usually illustrated with a circle and a triangle.

Hue is the color regardless of its intensity. If the colors are placed around a circle in spectrum order, hue is the angle measures at the center.

Saturation is the intensity of a color. Low saturations are gray, high saturations often overload the screen display and “bloom” or glare.

Value is the brightness of a color. If you set saturation to 0, Value determine the shade of gray you get. It’s also known as level.

Some things to know about Jitter in general

Jitter is an extension of Max consisting of a batch of specialized objects and a library of code the objects can access. Most jitter objects are named “jit dot something”, a naming convention we started to see when the number of Max objects exceeded a thousand. Most jitter objects are extremely complex; so much so that the old system of a list of numbers to initialize object and special purpose inlets to adjust parameters just won’t work. Instead there is a system of commands and attributes. For instance, the jit.rota object rotates images. There is no rotation angle inlet—to change the rotation, you give it the command “theta n” where n is the angle of rotation. To start out with a fixed rotation, include @theta n in the arguments. Either will set the theta attribute to n, and jit.rota will rotate any input by n radians. Most jitter objects will provide information out of the right outlet in response to the getattributes message (a listing of attributes) or the getstate message (current settings of all attributes).

Jitter is designed for the efficient manipulation of large batches of data. The general container for this data is the jit.matrix. The arguments to jit.matrix set the name of the matrix, the number of “planes” per cell, the type of data to store, and the size of each dimension. So [jit.matrix myData 4 char 320 240] is a matrix called myData. When a matrix receives a bang the only thing output is the name, in the message “jit_matrix myData”. Objects that do jitter processing will go to the original myData array and change what is found there. This is much more efficient than moving bytes from object to object. Another benefit of matrix names is that you can have another jit.matrix myData, in your patch and it will refer to the same data. Most objects will pass along the name once they are through processing, so the data in a matrix connected to a string of objects is processed in the same order as if the data were passing through. You don’t have to give a name to matrices-- Jitter will supply one if you don’t.

The data type can be char (8 bits), long (32 bit integer), float32 (32 bit floating point number) or float64. The ability to specify type not only saves space, it guarantees that operations will be as efficient as possible. It is much faster to process a couple of chars than two longs with 24 0s in each. When each operation is done more than a million times per frame, this kind of detail is important.

The concept of planes may seem a bit odd to seasoned programmers, but it is useful. Instead of thinking of a three dimensional array, users can envision a 2D array with cells that each contain 4 values. The only time planes are specifically addressed is if you want to work with just one color value of the pixels. Other graphics programs may refer to the red plane as the red channel, but audio people have enough channels in their lives.

The Jitter Video Chain

Jitter uses QuickTime for most video chores. (PC users will have to install QuickTime for Windows before using Jitter.) Video input is done with jit.qt.grab, and movie playback with jit.qt.movie. Both of these require two arguments to set the resolution of the image. 640 by 480 is a pretty decent screen resolution, but that means at least 1,228,800 bytes of data must be processed within the 33ms between each frame. This is possible, but you will usually find a 320 x 240 resolution to be more comfortable, giving you four times the performance. (I usually develop patches at 320 x 240, then make a high resolution version of things I like.)You should realize from the beginning that if Jitter can't finish the processing of a frame in time, the next frame will be skipped and the frame rate will be cut in half.

If you give jit.qt.movie a name for an argument, it will render the video directly to a jit.window of that name. Otherwise the output is a matrix name message.

Jit.qt.movie has enough commands and attributes to actually edit a mov file. The most important are read, start, stop, and loop (0 for off, 1 for on, 2 for back and forth.) Once a mov file has been read, bangs will cause video frames to be output. The frame that you get is the one that is appropriate to the elapsed time since the movie was started or loaded. The start and stop affect the running of the jit.movie clock, not the output of matrices. That's dependent on bangs. You get a frame per bang, so if you are banging faster than the frame rate of the movie, you will get repeats of the same image. It's probably best to use a metro rate close to the actual rate of your monitor, even though many examples use 2 ms. You should also probably use qmetro instead of metro to provide the bangs. If you use metro, heavy processing will make interface objects sluggish. The qmetro object prevents this by giving jitter processing lower priority.

Matrices output by jit.movie or jit.grab are of type 4 char, with the dimensions of the resolution. They can be processed by dozens of objects, from simple math to complete effects packages.

After the images are processed, they can be shown immediately by a Jit.pwindow (the palette object with the picture of a cat- it shows images in patchers) or jit.window, which opens a new window with just the image. The images can also be immortalized by jit.qt.record or jit.vcr.

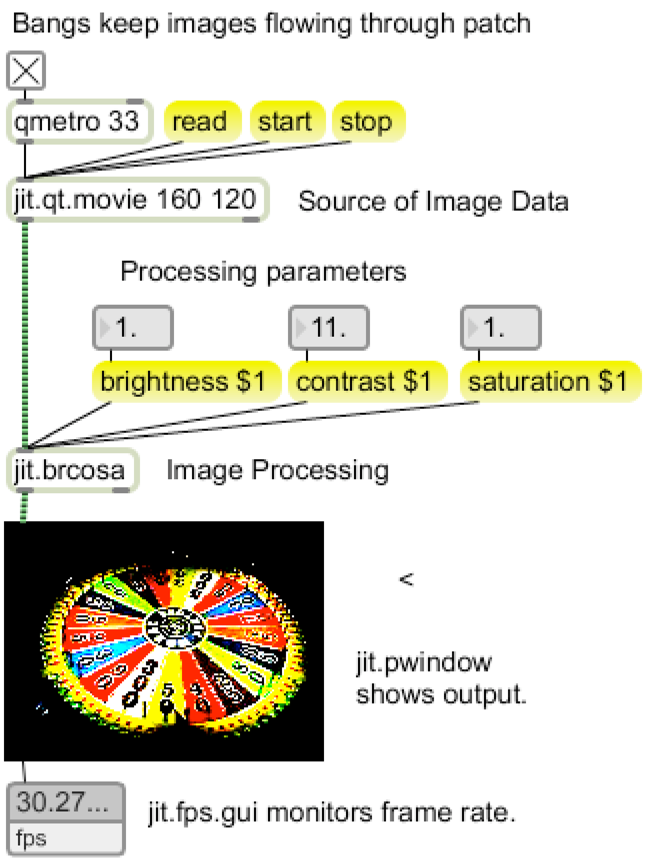
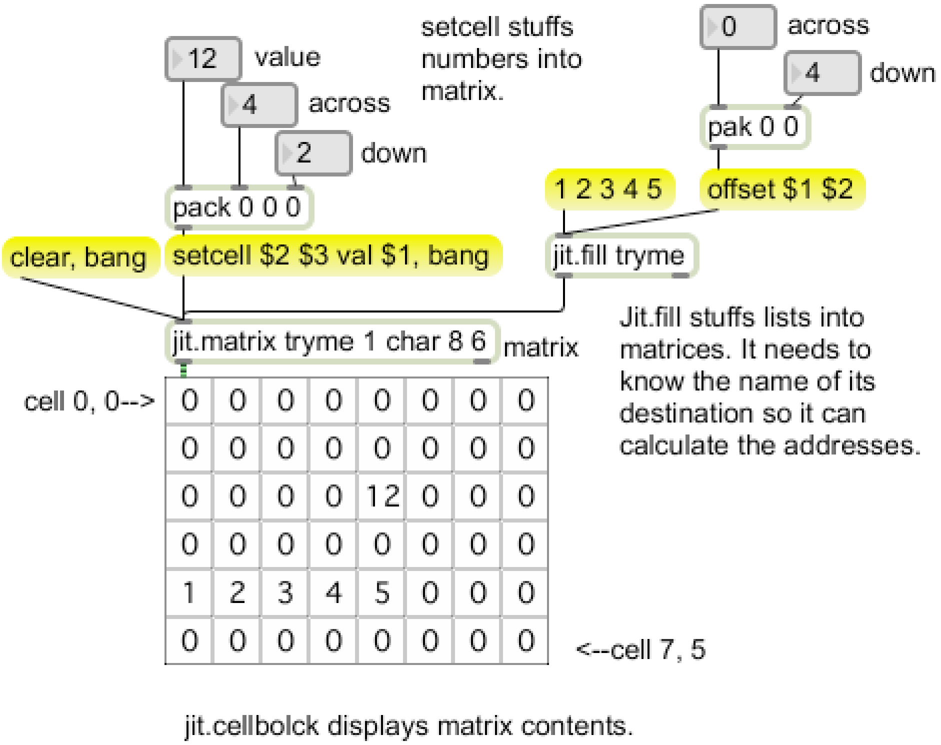


Figure 1.

The real action of jitter is in the image processing. This is done by doing math on the images.

The Care and Feeding of Matrices

Here's a matrix called tryme that is 8 cells across and 6 down. The jit.cellblock object shows the matrix contents in a spreadsheet.



setcell stuffs numbers into matrix.

Jit.fill stuffs lists into matrices. It needs to know the name of its destination so it can calculate the addresses.

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	12	0	0	0
0	0	0	0	0	0	0	0
1	2	3	4	5	0	0	0
0	0	0	0	0	0	0	0

jit.cellbolck displays matrix contents.

Figure 2

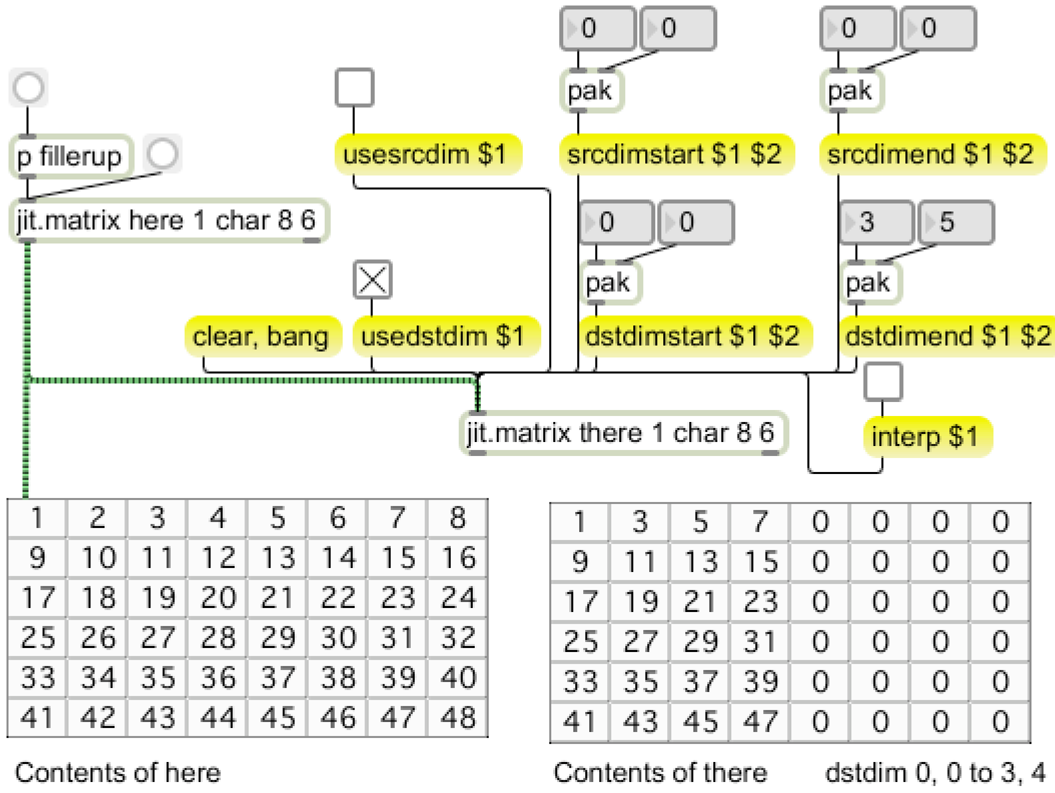
Each cell has a distinct address. The first cell always has an address of 0, 0 for a two dimensional matrix. The last cell is "one less than the width", "one less than the height". The message "setcell x y val n" will place the value n at the cell addressed x,y. Here the value 12 was placed at the cell addressed as 4,2. That's in the fifth column because the first column is address 0. If you try to set a cell that does not exist, nothing happens.

The object jit.fill will stuff a list into a matrix. You need to include the name of the destination matrix as an argument to jit.fill so the cell addresses can be properly calculated. Matrices can have their dimensions changed, and with the name of the destination matrix, jit.fill can automatically make sure it's placing data at legitimate addresses. The offset x y message to jit.fill determines the cell that will get the first member of the list. If the list is too long to fit in a single row, it is 'wrapped' into the next row.

Sometimes you do want to move data from one matrix to another. When this is done, interesting things happen if the matrices are different sizes. If the adapt flag is on (@adapt 1, which is the default) the second matrix will change its own dimensions to fit the data. If the adapt flag is 0 and the interp flag is on (defaults to off) the data will be adjusted to fit the new size: the corner cells will have the original values, but anything in between will be changed if necessary to give a smooth set of numbers. When adapt and interp are both off, numbers will be skipped if there is not enough room for all of them, or duplicated to fill larger spaces.

A matrix also has a pair of attributes called srcdimstart and srcdimend. If the attribute use usesrcdim is on, only the data between the source dimension start and source dimension end points will be accepted. Likewise there is dstdimstart and dstdimend, which in the presence of usedstdim = 1 will determine where the data goes. If the interp flag is set, data will be smoothed according to the size of the destination dimensions.

Figure 3 is a patcher that demonstrates various ways of moving data from a matrix called here to one called there.



1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48

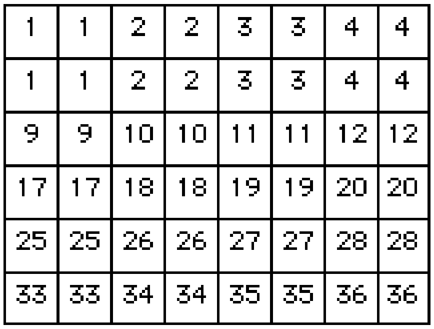
Contents of here

1	3	5	7	0	0	0	0
9	11	13	15	0	0	0	0
17	19	21	23	0	0	0	0
25	27	29	31	0	0	0	0
33	35	37	39	0	0	0	0
41	43	45	47	0	0	0	0

Contents of there dstdim 0, 0 to 3, 4

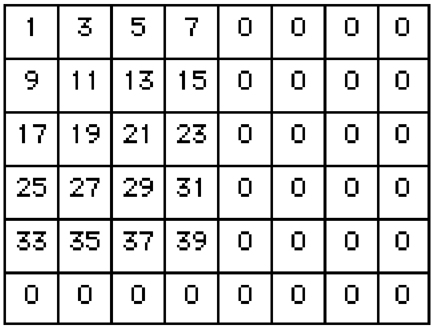
Figure 3

Here are some trials with various settings:



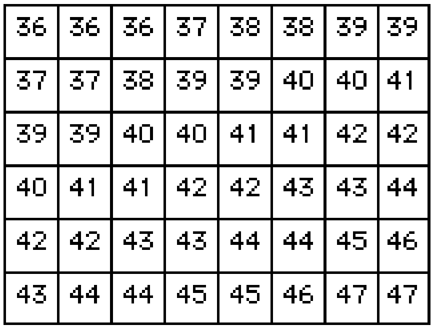
1	1	2	2	3	3	4	4
1	1	2	2	3	3	4	4
9	9	10	10	11	11	12	12
17	17	18	18	19	19	20	20
25	25	26	26	27	27	28	28
33	33	34	34	35	35	36	36

srcdim 0,0 to 3, 4
interp 0



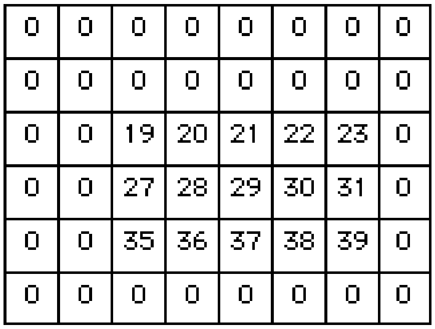
1	3	5	7	0	0	0	0
9	11	13	15	0	0	0	0
17	19	21	23	0	0	0	0
25	27	29	31	0	0	0	0
33	35	37	39	0	0	0	0
0	0	0	0	0	0	0	0

dstdim 0,0 to 3, 4
interp 0



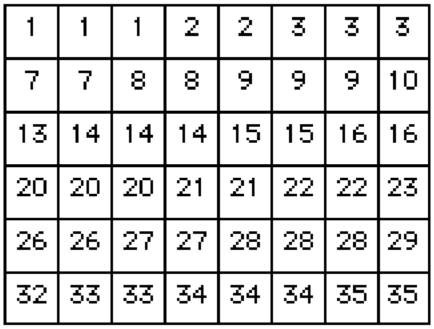
36	36	36	37	38	38	39	39
37	37	38	39	39	40	40	41
39	39	40	40	41	41	42	42
40	41	41	42	42	43	43	44
42	42	43	43	44	44	45	46
43	44	44	45	45	46	47	47

srcdim 3,4 to 7, 5 interp 1



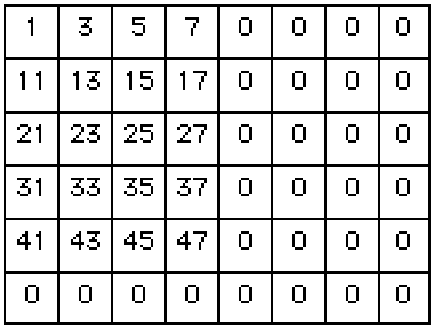
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	19	20	21	22	23	0
0	0	27	28	29	30	31	0
0	0	35	36	37	38	39	0
0	0	0	0	0	0	0	0

srcdim 0,0 to 3, 4 interp 0
dstdim 0, 0 to 3, 4



1	1	1	2	2	3	3	3
7	7	8	8	9	9	9	10
13	14	14	14	15	15	16	16
20	20	20	21	21	22	22	23
26	26	27	27	28	28	28	29
32	33	33	34	34	34	35	35

srcdim 0,0 to 3, 4 interp 1

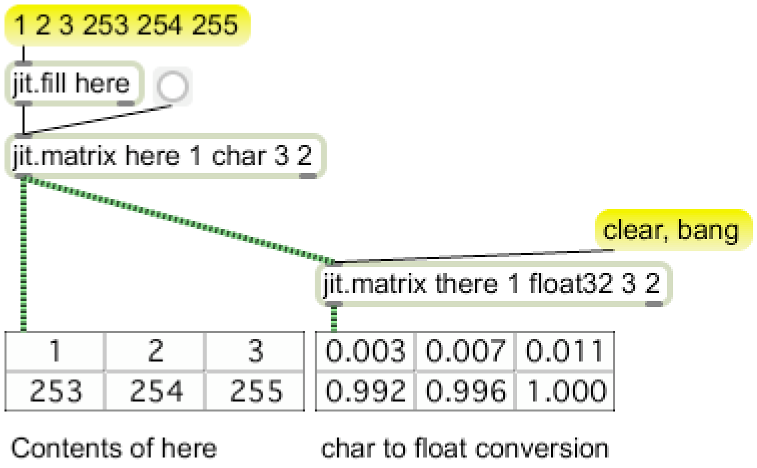


1	3	5	7	0	0	0	0
11	13	15	17	0	0	0	0
21	23	25	27	0	0	0	0
31	33	35	37	0	0	0	0
41	43	45	47	0	0	0	0
0	0	0	0	0	0	0	0

dstdim 0,0 to 3, 4 interp 1

About data type conversion.

Here’s a version of the here to there patcher that demonstrates a startling feature of jit.matrix



1	2	3
253	254	255

0.003	0.007	0.011
0.992	0.996	1.000

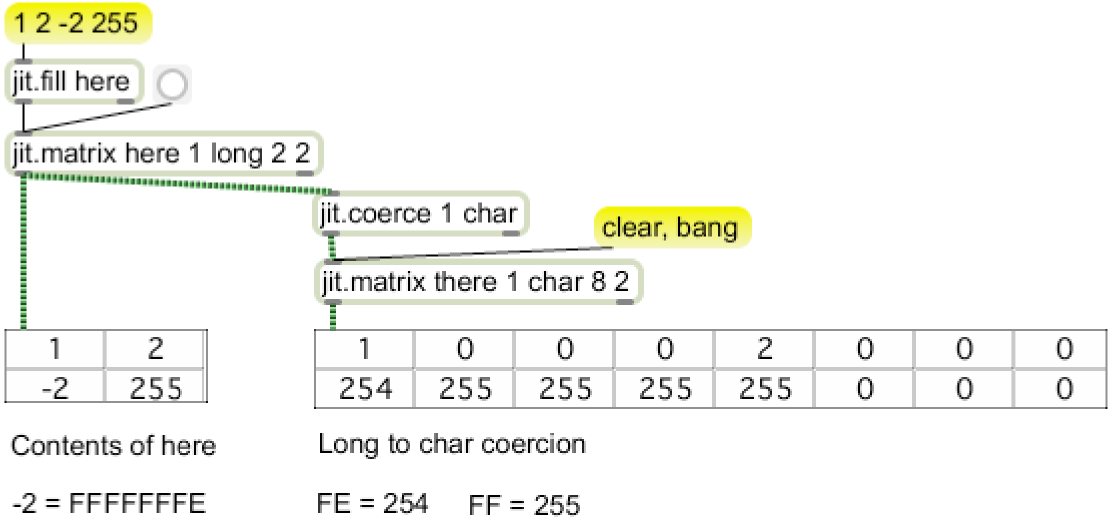
Figure 4.

When you send char data to a matrix of float data type, the results are rescaled to comply with what is considered the “normal” use of Jitter. The range of char data types is 0-255 because that’s all 8 bits will hold. Float32 can have enormous values, but in audio and video, most of the action is between -1.0 and 1.0. Therefore, chars are routinely converted to the range of 0 to 1.0. This happens in setting attributes too, although there is a bit of inconsistency in some of the objects.

Going the other way, floats between 0 and 1.0 are converted to chars from 0 to 255. If a float is larger than 1, it will be converted, but with peculiar results.

Actually, there’s seldom any reason to convert these types of data without rescaling, but if you need to get from char to float with the same values, run the matrix through a jit.matrix of type long first.

Another type of conversion involves keeping the same bits but reinterpreting the meaning, so that a single long becomes four chars or vice versa. The jit.coerce object will do this.



1	2
-2	255

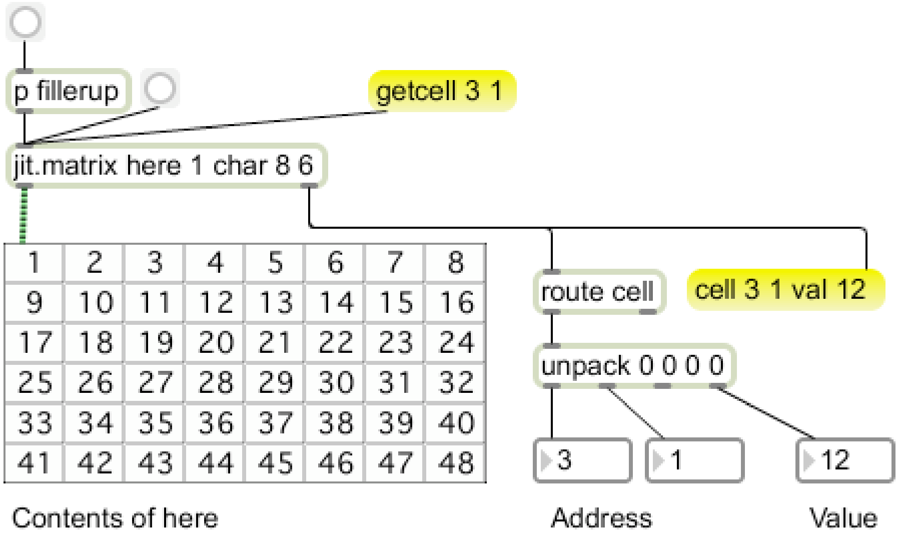
1	0	0	0	2	0	0	0
254	255	255	255	255	0	0	0

Figure 5.

Coercion is shown in figure 5. Note that the byte order is little-endian[2]. Coercion is rare, but occasionally invaluable.

Getting information out of matrices[3]

The getcell command is the compliment to setcell.



1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48

Figure 6.

[2] Lowest significant byte is first. A value that reads (in hexadecimal) FFEEAA01 fills memory in the order 01|AA|EE|FF.

[3] To get information about a matrix, use the getstate message. It will dump a lot of messages from the right outlet. Once yo know what to expect, you can filter particular attributes with route.

Getcell provokes a message from the right outlet with cell address and value(s). You can use route cell and unpack to separate the numbers from the labels.

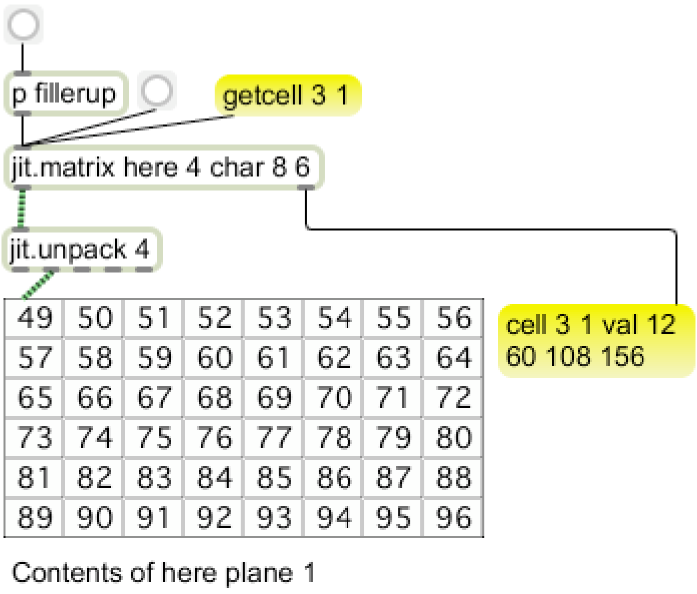
Jit.spill will extract part of a matrix as a list. It has listlength and offset attributes to pick the data you want. A list is limited to 256 values.

Managing Planes

Setcell works easily with multiplane matrices. You can simply list enough values to fill a cell, or address a plane directly with a message like [setcell 2 4 plane 1 val 7]. The getcell message will list all cell values unless you specify a plane after the address.

Jit.fill will only fill one plane, which is specified with a number argument after the matrix name. You can change these with input messages by the way. A symbol is a name for a new matrix target, and an int changes plane. In jit.spill, the plane number is an attribute, set with the @plane argument or the plane message.

Jit.pack will combine matrices into a multiplane version. If you want to extract a whole plane as a matrix, there is the jit,unpack object.



49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64
65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96

cell 3 1 val 12 60 108 156

Contents of here plane 1

Figure 7.

Addressing

The fillerup subpatch of Figure 7 stuffs the cells of ‘here’ with numbers as the cellblock shows. It’s worth looking inside fillerup because it illustrates a good method for generating addresses.

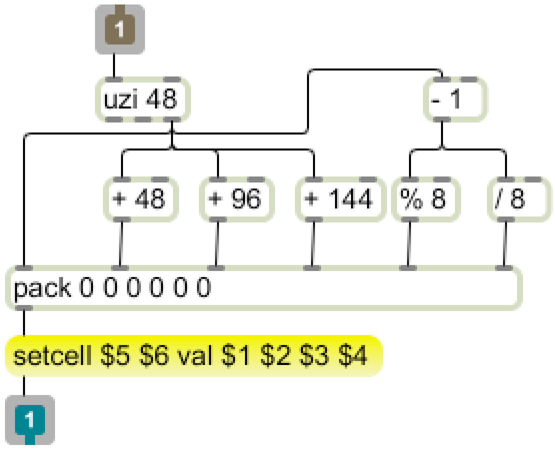


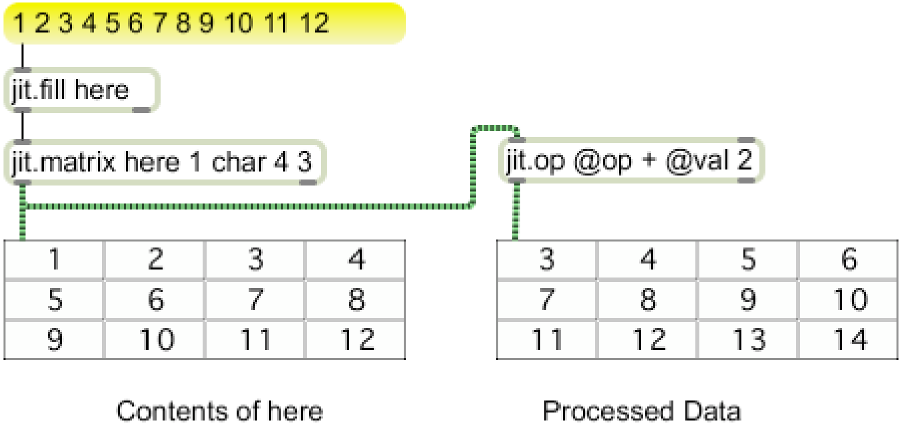
Figure 8.

The uzi will give us the numbers 1-48 as fast as the machine can compute. To calculate addresses, we need to start with 0, so subtract 1 from the uzi output. Divide this by the width of the matrix to get the row number y, and use the remainder operation (%) to get the column x. All of this goes into the setcell message to place the uzi index and values derived from it in the matrix. To fill a 3 dimensional matrix, you would drive this with another uzi from the “watch out!” outlet and use the values of that uzi -1 to give the third dimension. It’s not a good idea to use uzis to fill very large matrices however. There have been instances of locking Max up that way. For big matrices, use metro and counter to produce the same stream of numbers at a more sedate rate.

You may want to save large matrices as .jxf files so you only have to calculate them once. You can also export matrices as jpegs, gifs or many other types. You can import these types into a matrix too. You can even import a frame of a mov file.

The Math of Matrices

The most important jit object is probably jit.op. This is a Swiss Army Matrix changer.



1 2 3 4 5 6 7 8 9 10 11 12

jit.fill here

jit.matrix here 1 char 4 3

jit.op @op + @val 2

1	2	3	4
5	6	7	8
9	10	11	12

Contents of here

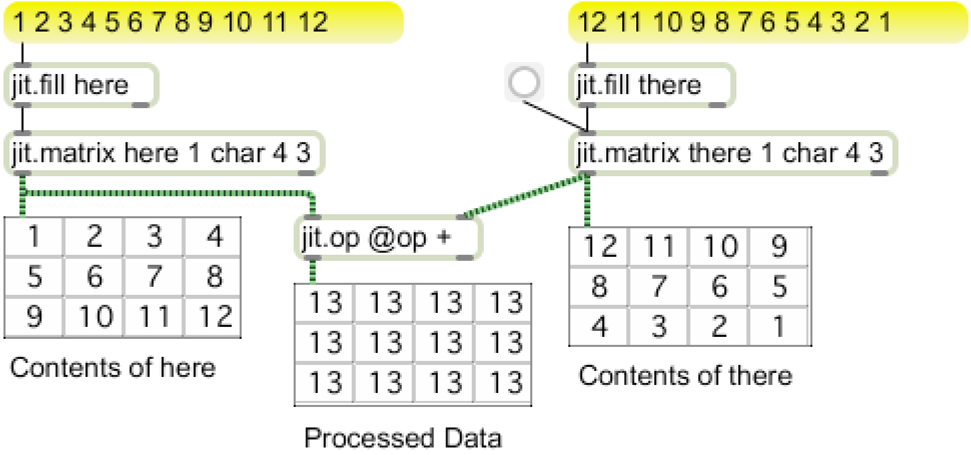
3	4	5	6
7	8	9	10
11	12	13	14

Processed Data

Figure 9.

The main attribute of jit.op is the op, which can be any of fifty operations from acos to xor. The op can be specified with the @op argument as in figure 7, or on the fly with messages like op -. The operand is specified with @val as an argument or with the message val n. If you are working on multi-plane matrices, you can have a different ops and vals for each plane. If you want one plane to be unaffected, use pass as the op.

Jit.op will process one matrix with another.



1 2 3 4 5 6 7 8 9 10 11 12

12 11 10 9 8 7 6 5 4 3 2 1

jit.fill here

jit.fill there

jit.matrix here 1 char 4 3

jit.matrix there 1 char 4 3

jit.op @op +

1	2	3	4
5	6	7	8
9	10	11	12

Contents of here

13	13	13	13
13	13	13	13
13	13	13	13

Processed Data

12	11	10	9
8	7	6	5
4	3	2	1

Contents of there

Figure. 10

It's pretty simple really. But powerful. Figure 11A shows how jit.op with a simple multiply will fade an image.

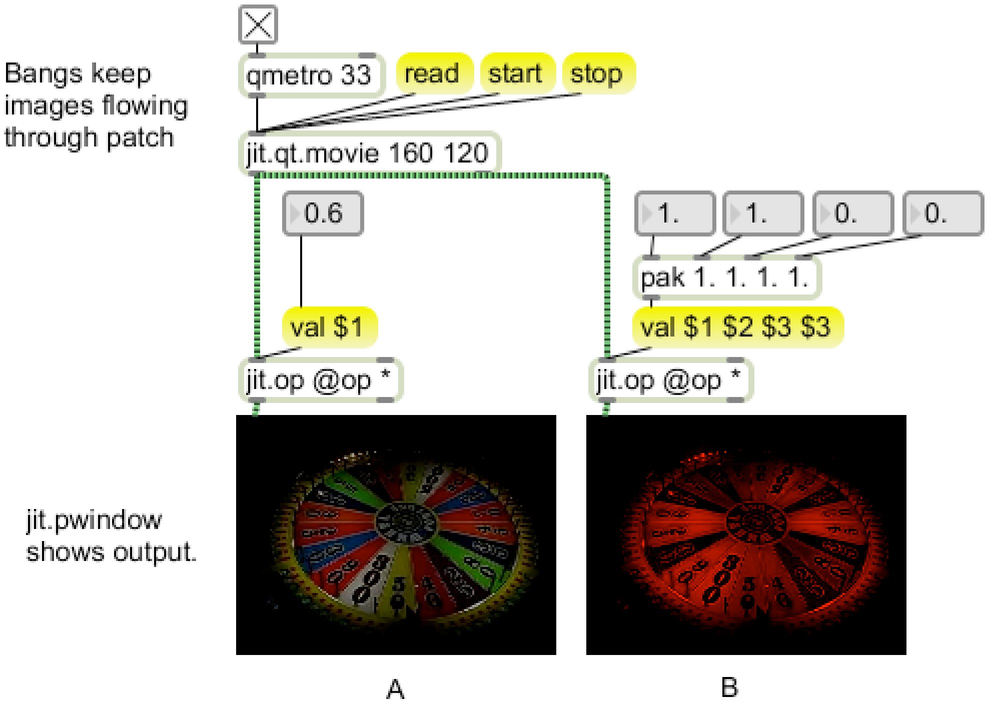


Figure 11.

In figure 11B, each color plane is faded individually. The four planes in a video matrix are alpha (opacity), red, green, and blue. A Red value of 1.0 will pass the red values unchanged, and a green value of 0.0 means no green at all. Note the pak object in figure 11. This is just like pack, except an output occurs when any input is received.

Showing your work

These examples use jit.pwindow to show images. Pwindow is found in the object palette, where it has a picture of a cat. There is an inspector for jit.pwindow that lets you set its size and a few options. One of these is “doublebuffer” which smoothes screen redraws in system 9 and on PCs. It’s unnecessary in OSX, so you can turn it off for a significant increase in processing speed.

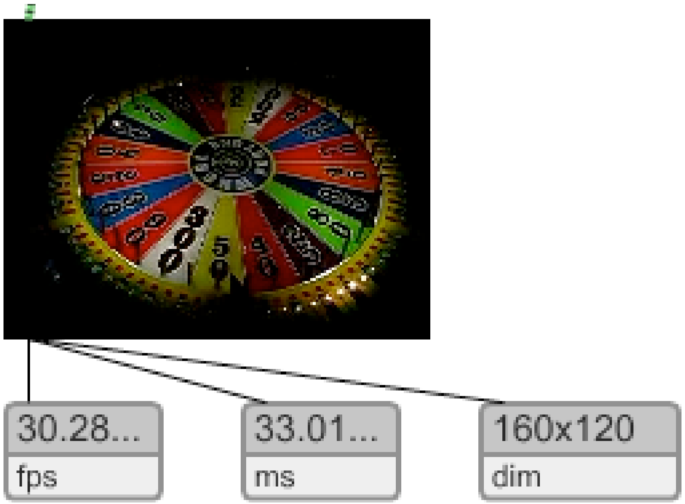


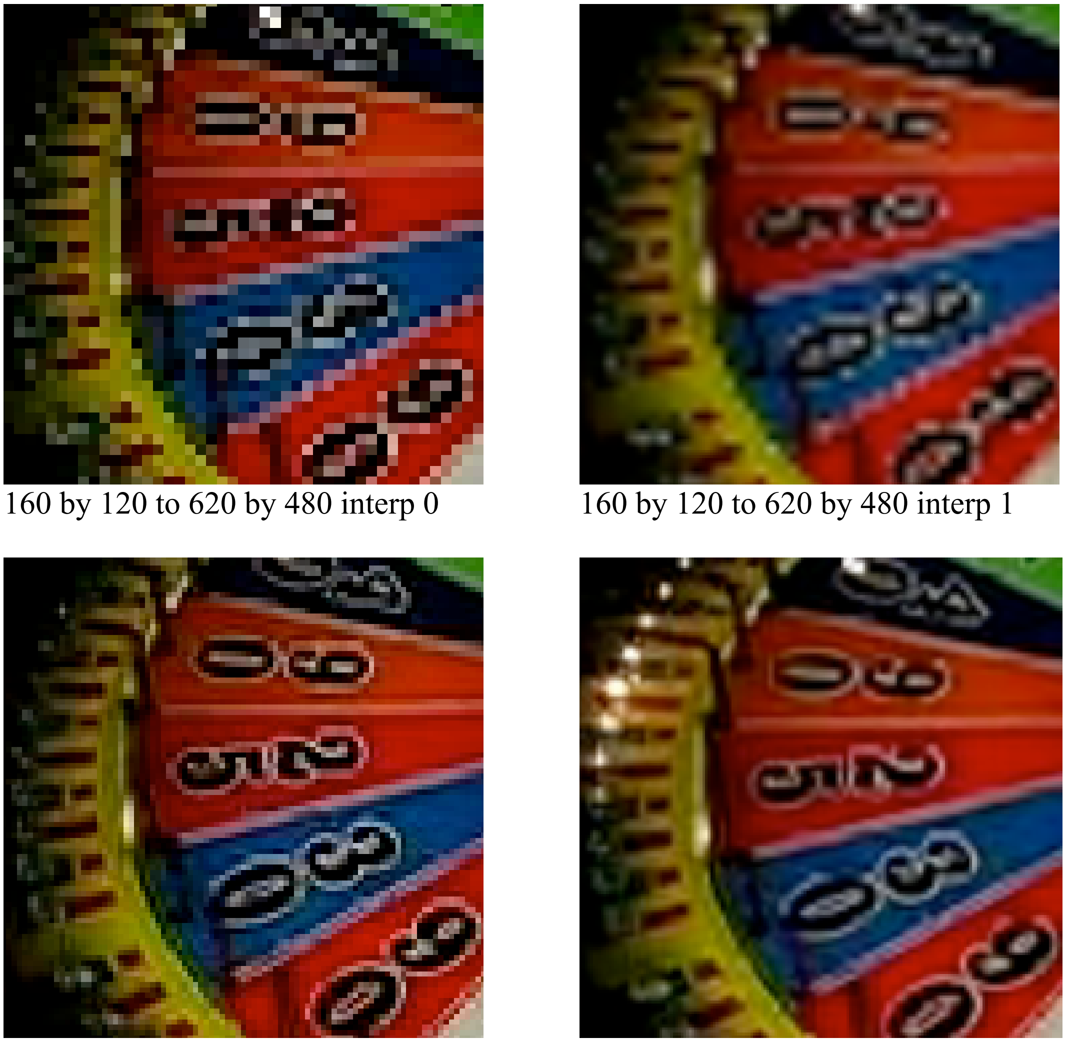
Figure 12.
We often follow the pwindow with jit.fpsgui, which can (by virtue of a drop menu) show various information about any matrix. Jit.fpsgui is also in the palette, labeled fps. Fps is the most interesting parameter to watch, as it can tell us a lot about the health of our patch.

Jit.window

For serious display, use jit.window. You should give all jit.windows names, because the name is displayed in the title bar, and if you don’t specify, jitter will call it something like u87800059. To position a jit.window use the @rect attribute to start out and the rect command to resize the window. You can change its position with the position message, specifying the top left corner.

Rect takes four numbers. The first two are the location of the upper left corner of the screen image (not the title). This is the count of pixels right and down from the upper left corner of the primary display. The other two numbers are the position of the lower right corner. (Technically, the corner falls between pixels, so this is the address of the pixel just outside and below the window.) The size of the window is the right minus the left by the lower minus the upper. To center the window on the display, subtract half the window size from half the display size and use that for the upper left coordinate. So to center a 320 by 240 on a display 1024 by 768, use @rect 352 264 672 504. To expand it to 640x480 send the message rect 192 144 832 624.

When a small image is sent to a large jit.window, the image is resized without interpolation. If there's much enlargement, the result can be pretty rough looking. The interp flag turns on interpolation, which is quite good, but will look strange if you try to get beyond 2:1.



160 by 120 to 620 by 480 interp 0

160 by 120 to 620 by 480 interp 1

320 by 240 to 620 by 480 interp 0

320 by 240 to 620 by 480 interp 1

Figure 13.

Other important flags for jit.window.

- fullscreen -- expands the window to fill the display.
- fsmenubar – shows the menubar in fullscreen mode. Defaults to 1.
- floating – make the window float over all other applications. If it is not floating, the front command will bring a hidden window out.
- visible – visible 0 will make it disappear.
- border – if 1, the title bar will show. You can't have a floating window with no title bar.

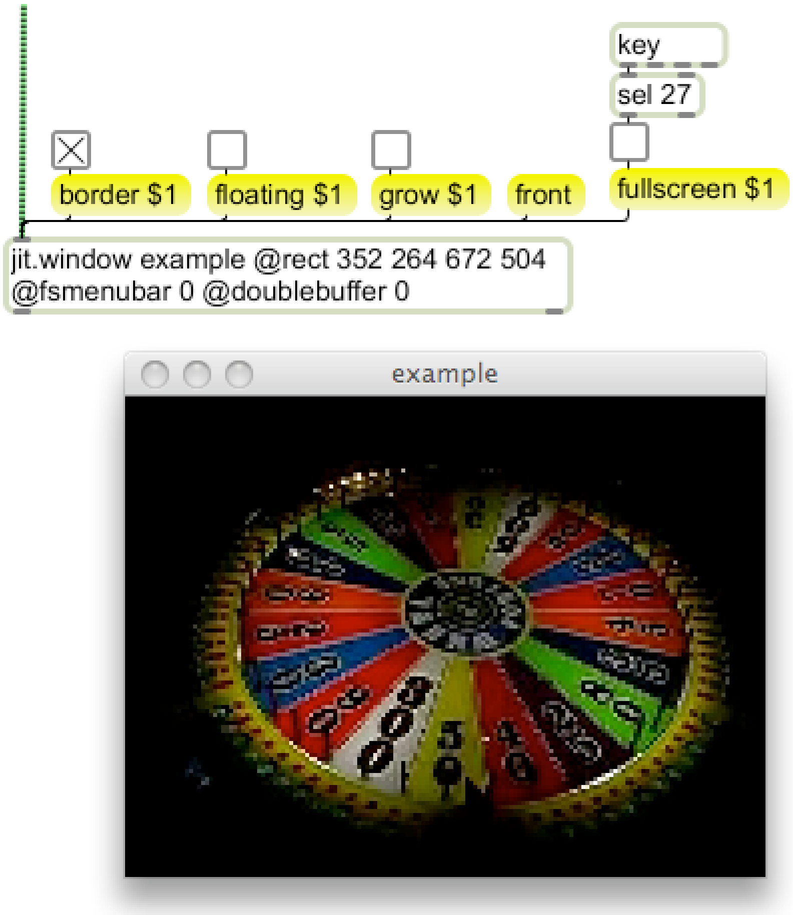

key
sel 27
border $1
floating $1
grow $1
front
fullscreen $1
jit.window example @rect 352 264 672 504 @fsmenubar 0 @doublebuffer 0
example

Figure 14.

Figure 14 shows one way to use jit.window. Notice that a key (escape) is used to toggle fullscreen mode. Otherwise it would be difficult to get back to the patcher window.

Jit.window can be sent to a second monitor (my favorite way to use it). If the monitor is set to the left of the main monitor with a resolution of 800 by 600 @rect -800 0 0 600 will put the jit.window there. If you don't know where the other monitor will be, you can use the jit.displays object to find the coordinates. The message cords 1 would get the message cords 1 -800 0 0 600 in the case described. Jit.displays can do anything the displays preferences panel can, and a bit more.

Mouse operations

The jit.window can be dragged and resized with the mouse. To find out where the window is, use the getstate message, with route pos size.

If you click in the jit.window, the right outlet of the object will produce the message mouse, with position of the click in the window, a flag for mouse down or up and flags for modifier keys: command, shift, caps-lock, option, control. Note that the message is only sent on mouse up or down. The idlemouse message enables mouseidle output when the cursor is over the window without clicking.

Testing mouse clicks, you will notice you can't get a response from the lower right corner. That's because there's an invisible grow box there for resizing the window. The grow 0 message will disable resizing, and you will get clicks from the entire window.

Jitter Efficiency

Using jitter is a constant battle between great ideas and limited processing power. You will watch the fps meter inexorably grind to a low number as you add modules to your patch. The ultimate solution lies with Apple and Intel, but until 8Ghz 8 core machines are a reality, all you can do is follow these guidelines:

- Keep a clean system. Don't install a scanner, disconnect all unneeded peripherals, and close all extraneous applications. Do install lots of memory.
- Fast drives are key.
- Use activity monitor to check what's running and how much CPU each application takes. If it's 0% don't worry about it, but Max should be the biggest user. As an extreme example, Adobe InDesign can easily gobble 40% of the CPU time on a 2 GHz machine.
- Remove all unneeded Max UI objects. Use [t b] instead of button to convert messages to bangs (It doesn't even matter if they show on the screen). Don't hang number boxes all over, use your midi controller (really-- the number box has to be constantly monitored, Midi only takes attention when it comes in.)
- Keep the use of pwindows to a minimum.
- Keep your MSP operations efficient. MSP can easily use just as much CPU as Jitter. Jitter is more likely to suffer, as graphics have a lower priority.
- Turn overdrive off. Don't use scheduler in audio interrupt if you can help it.
- Use qmetro instead of metro. Qmetro waits until processes have finished before banging. Metro interrupts other actions, which uses more processing time in the long run.
- Set the qmetro to 33 ms. This will give you a frame rate of 30 fps tops, but there will be less variation than if you try to go faster. The FSPGUI is only counting bangs out of the window, not what's drawn to the screen. The screen is actually updated at 70 fps or so but we don't mind seeing the same frame twice at that rate. There's no point in calculating images you never see, and other parts of the patch will be grateful.
- Never use a complex object if jit.op will do. Complex objects are… complex, and they may be doing unneeded operations like multiplying by 1 or copying matrices. Using jit.brcosa to control brightness rather than jit.op cost 10 frames on a iMac.
- Never use two objects if the functionality of one is built into another. You wouldn't use jit.rota and jit.resamp together, since rota has a zoom feature.
- Bypass temporarily unneeded objects. If you set theta to 0 and zoom to 1, nothing is happening, so use a gate to bypass the jit.rota object. (Don't use a switch, that would feed both objects at the same time. Jitter objects do their processing when they get a message, whether there's anything hooked up or not.)