PEEK 360 : 3D Photo management & Object archive calculations

NOTE : The term ARCHIVE in this section refer to a graphical file (JPEG) containing pre sorted images representing a partial or full 3D object. Keep user entries within yellow labeled cells. You may preview 3D Photo Object samples from the web at http://www.ipixel.no/360

Open the *360calc.xls* spreadsheet and focus the **OBJ** label. This sheet both calculates the 3D object archive layout as well as object rotation and camera orientation when framing the object. The upper part of the calculator is primary used to identify the object construct (number of frames, columns and rows) and object / camera setup (rotation, tilt and elevation) to use during a photo session. The lower part calculates the best efficient archive layout depending on the size of the object as well as the viewer. The calculator may be useful when planning a photo session, manually constructing any 3D object archive or cropping / resizing an existing archive (compressed JPEG or similar).

3D object framing

First of all you have to determine the object construct when creating an interactive 3D photo model, that is, the number of frames to use animating both the horizontal and vertical rotation of the object. The model is divided in vertical rows representing a 180° (+90° | -90°) or partial shift of view from top to bottom. Frames within each row represent a 360° or partial shift of view from left to right (clockwise object rotation). The calculator default is 16 photo spots to animate a 360° single row rotation. Increasing the number of spots (eg 32 or higher) will result in a smother horizontal animation thus a larger target JPEG archive to download. When creating a multiple row object you may loose up on the vertical shifts as the vertical rotation in most cases is a non-preferred user interaction. This is why many authors make use of multiple rows to alter the state of the object rather than shifting the vertical plane, eg displaying multiple object colors or object attachments when user toggle the mouse vertically.

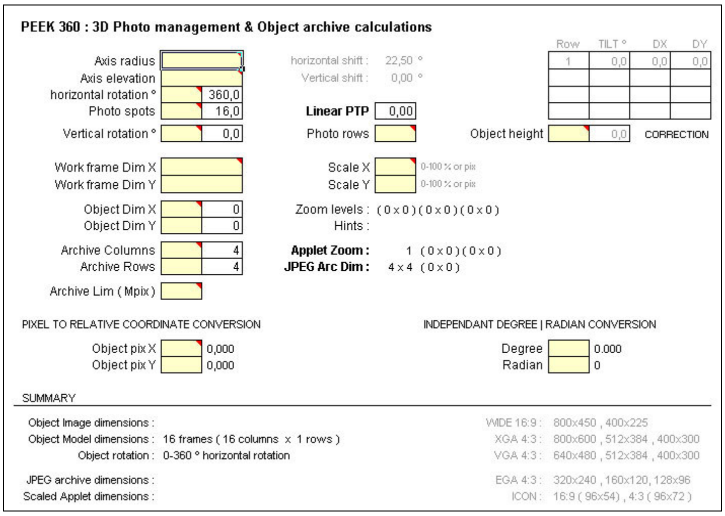
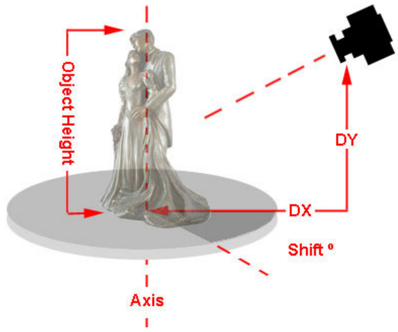


Photo session using a rotating object

When framing small objects it is often more convenient to rotate the target object rather than moving the camera around the object. A home-made *object wheel,* using a rotating TV- or monitor table plate, might be a rational substitute to expensive camera kits. Adjust the camera on a tripod, make sure to center the object on the object wheel (plate) and then rotate the wheel between each shot. 360calc will calculate the preferred horizontal shift (angle) between each frame depending on the number of horizontal photo spots in the animation. When shooting multiple rows, enter the number of vertical planes (photo rows) and the distance between the rotation axis and the camera lens in the horizontal plane (axis radius). 360calc will set up a maximum of 4 vertical shifts, calculating the lens distance from the rotation axis (DX), vertical elevation from ground level (DY) and downward lens tilt. You may correct lens elevation (ground to lense) by specifying the object height. This will lever the animated tilt axis from ground level to the center of the object.



EG : We decide up on a 360° horizontal by 60° vertical rotation when constructing the 3D model of a bronze statue, using 3 vertical shifts divided in 24 frames through out the horizontal rotation. The height of the statue is 20 cm and to retain a proper focus the camera lens distance from the object center is 50 cm. (1) Use 360calc to enter the vertical rotation and number of rows. (2) Set the proper lens distance (axis radius) and alter the number of photo spots to 24. Default horizontal rotation is 360°. (3) When entering the object height of 20, all lens elevations is corrected by 10 to lever the vertical tilt axis to the center of the object. (4) Adjust the camera using the upper row settings and rotate the object by 15° (calculated horizontal shift) between each of the first 24 shots. Repeat the procedure using the next row lens adjustments and a parallel sequence of horizontal shifts.

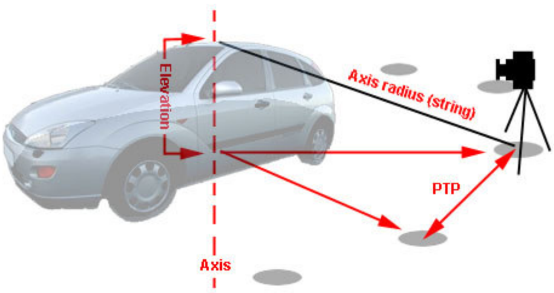


Photo session using a rotating camera

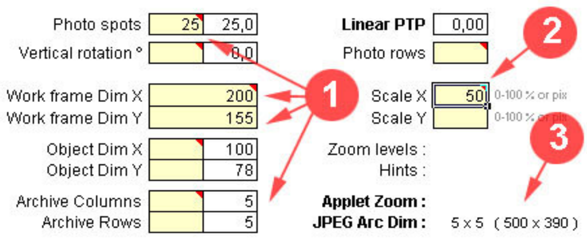
Moving the camera around the object is often the only rational (possible) solution when framing large objects (car, houses etc). You may use a thin nylon string attached to the center axis of the object to retain a strict radian distance through out the session. When framing a 360° rotation it is important that the horizontal shift between each photo spot is identical. If you stretch a nylon string from the centered top of the object to the ground, you may move around the object in a perfect circle, marking the individual photo spots. Enter the string length as axis radius and string height as axis elevation (if the string span is tilted). 360calc will calculate the preferred horizontal shift and correct linear PTP distance between each photo spot depending on the number of horizontal frames in the animation.

EG : When framing the 3D model of a car we decide up on a 360° single row rotation, using 16 frames through out the horizontal rotation. The height of the car is 1.46 m and we have attached a 4.2 m nylon string from the lens to the center top of the car. Enter axis elevation = 1.46 and line length to axis (former axis radius) = 4.2. 360calc now calculates a PTP distance of 1.54 m. This is the correct distance between each of the 16 photo spots using the string span to outline the circle.

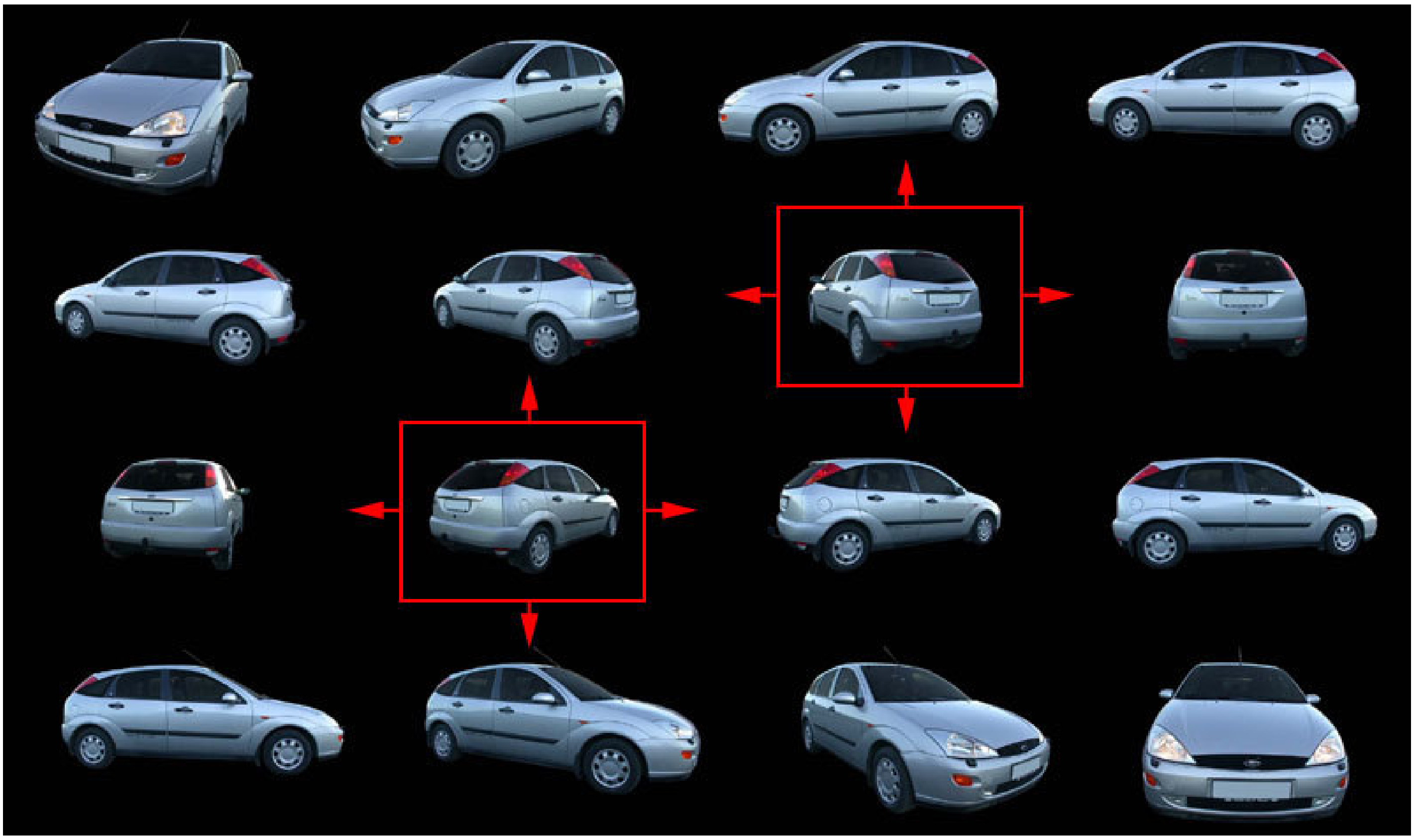
Object archive calculations
You may prefer to use a 3D photo object software solution (eg iSeeMedia PhotoVista 3D objects) when aligning your frame shots into an object archive. Working with a image resolution higher than the resulting object will render several advantages in aspect of image aligning and quality (minimum VGA). In contrast to recommendations from some object software vendors you may actually recompile, resize, stretch and / or reorganize the target archive at any time as long as you withhold the integer object boundary within the archive. 360calc solves this by calculating the object frame size rather than the target archive size.

Object preferences and archive (re)sizing
Enter the pixel width and height of your object frame shots (work frame dim) along with the total number of frames (photo spots and photo rows). When working with an existing archive you should also check whether the organized archive layout matches the default calculated archive columns and rows (correct if necessary). When (re)sizing the target archive file both image aliasing and archive download size should be taken in consideration. Some viewers (like iSeeMedia Objectapplet.jar) suffer under anti-aliasing issues. Unless you want the ability to HQ zoom in on the object, either the resulting object width or height should align the viewer dimension (eg object width equals viewer width as long as object height does not exceed viewer height, or the other way around). Use scale X / Y either to resize the work frames prior to stitching or resize the object dim X / Y in an existing archive. 360calc will calculate the corrected archive dimensions (JPEG arc dim) as well as presumed zoom levels, preferred viewer dimensions and scale hints. Use any photo editor (eg Photoshop) to resize the archive using the calculated proportions.

EG : The single row object model counts 25 frames, each frame is 200 x 155 pix, aligned in 5 rows by 5 columns within the JPEG archive. The dimension of the object archive is (200 x 5) x (155 x 5) = 1000 x 775 pix. When performing a proportional resize of the archive width by 0.5 in an editor, the resized archive dimension is 500 x 388. Dividing the new archive height by 5 rows will give an erroneous object height of 77.6 (resulting in a slightly bumping object when rotating it in a viewer). **Solution**: (1) Insert number of frames (photo spots) and frame width / height (work frame dim) in 360calc and verify correct archive columns / rows. (2) Use the scale X option and enter 50 to scale the work frame by 0.5 (50%). This will result in an 100 x 78 pix scaled object. (3) Scaled archive dimension is 500 x 390 pix.



The 3D object archive
The target JPEG archive layout is divided in rows and columns. This is due to imitations when reading large JPEG files (some browser JPEG decompressors that is built into Java tend to fail when rendering particulary wide images) and has no resemblance to the horizontal photo spots and vertical rows within the object model. When run through a 3D photo object viewer (eg. iSeeMedia objectapplet.jar) the archive file is read like a book from left to right, top to bottom. You may use any photo editor (eg Photoshop) to move, stretch and align masked objects as long as you withhold the integer object frame boundary within the archive.



Tip : Use the object viewer to detect any misaligned frames during the animated rotation. Ajusting the objects within a hiresolution archive will result in a smother alignment when later resizing the archive.

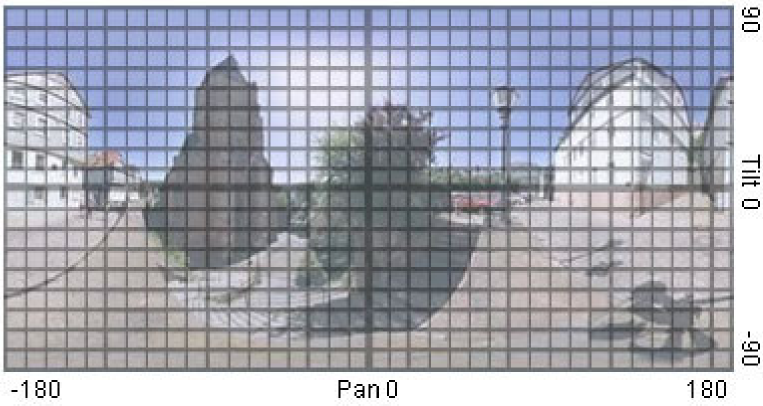
WIDE 360 : Equirectangular panoramic calculations

NOTE : The term ARCHIVE in this section refer to a graphical file (JPEG) containing a pre stitched spherical image representing a partial or full panoramic view. Keep user entries within yellow labeled cells. You may preview sample panoramics from the web at http://www.ipixel.no/360

Open the *360calc.xls* spreadsheet and focus the **PAN** label. This sheet calculates several aspects of the archive dimensions and the panoramic field of view. It may be useful when retrieving the missing FOV (field of view) of a panoramic, calculating archive dimensions (given a set of preferences) or capturing basic VRML viewer defaults (IVR settings). You may prefer to use a software solution (eg iSeeMedia PhotoVista or the more complex free Pano Tools) to stitch the panoramic archive.

The panoramic archive

The creation of VR-panoramas usually requires the assembly of several input images (stitched) into one environmental map. A full spherical panorama maps a 360° x 180° view to a flat surface. An equirectangular mapping algorithm with pan (-180° | +180°) and vertical tilt (-90° | +90°) as independent coordinates is often used. In the equirectangular projection, both horizontal and vertical axis are proportional to the viewing angle, giving an aspect ratio of exactly 2:1 in a full spherical panorama. The panoramic field of view may cover up to 360° horizontally (hFOV) and 180° vertically (vFOV). The view presented by a VRML viewer depends on the chosen pan, tilt and field of view angles, limited by the horizontal YAW range and vertical PITCH range.



Any size for the source panoramic archive may be used, thus memory requirements for image decompression may be quite large for some viewers. Assuming a pixel aspect ratio (PAR) of 1:1, the FOV relates to image size through the equation :
ImageDx / ImageDy = hFOV / vFOV

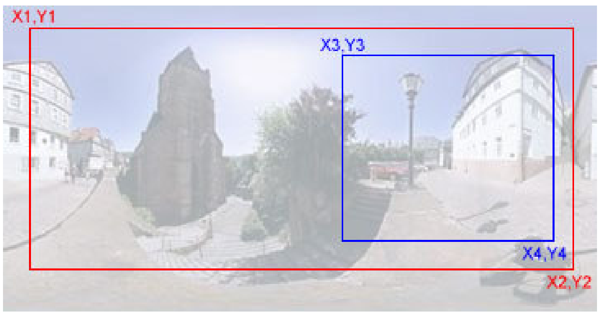
Calculating the panoramic FOV and archive dimensions

You need to know the archive dimension and either vFov or hFov to calculate a missing FOV (field of view). When working with a full panoramic the hFov is 360° and thereby *vFov = 360/(Dx/Dy)*. Otherwise, you can use the FOV specifications of your lens as vFov to calculate the hFov (assuming the panoramic archive is not cropped). Use 360calc to calculate the missing hFOV or vFOV. Enter the panoramic archive pixel width and height as Panorama Dim X | Y along width the known FOV value (use either degrees or radians). You may also use the calculator the other way around when setting up, resizing or cropping a panoramic canvas.

EG : To crop a full 3000 x 1500 pix panoramic image (360° x 180°) into a partial 120° vertical view, set hFOV 360, vFov 120 and panorama dim X 3000. 360calc calculates the new height of the panoramic image (1000) which may be cropped using any photo editor (eg Photoshop).

Limiting the panoramic FOV

Specify pitch- or yaw- correction to limit the panoramic view (user interaction) within a VRML viewer. Pitch and yaw are normally set as minimum and maximum pan or tilt angle coordinates, which in most cases require you to calculate image pixel borders as relative values to the FOV. Use 360calc to calculate the limits from archive pixel coordinates or set the pitch and yaw manually, using radian angles to segregate them from pixel values. You may also use the PIXEL TO VIEW CONVERSION to calculate any relative view (decimal coordinates between 0 and 1 representing a scale constant relative to the highest pixel value) or initial view within the panoramic archive. The initial view outputs the pan (-180,180), tilt (-90,90) and vertical view angle (0,180).

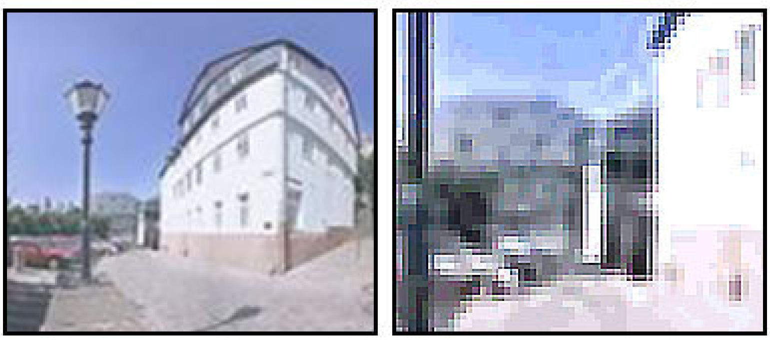


EG : Open the panoramic archive in Photoshop and use the marquee option to find a proper panoramic view area (red) and initial view FOV (blue). Enter the upper and lower pixel coordinates of the view area (Y1,Y2) as upper | lower pitch correction. Enter the left pixel coordinate (X1) (border margin) of the view area as the yaw correction. Enter X3,Y3, X4,Y4 of the initial FOV in the corresponding PIXEL TO VIEW CONVERSION cells. 360 calc will calculate the relative pitch, yaw and initial FOV to use in an IVR or APPLET script.

NOTE : 360calc calculate minimum (left) and maximum (right) yaw range based on an equal pixel margin on both sides of the panoramic (centered yaw). You may swap the horizontal and vertical inputs to calculate individual yaw limits using the upper and lower pitch correction.

Limiting the panoramic ZOOM

You may enter a minimum pixel resolution as preferred zoom resolution to calculate a correct minimum zoom angle according to the applet view. A resolution higher than 1 means the user will be able to zoom inn past the archive 1:1 resolution, risking disturbance in image quality. Default applet view area is 400 x 300 pix, but may be altered to any preferred view.



(pixelization)