The following appendix accompanies the article

Pockmarks influence benthic communities in Passamaquoddy Bay, Bay of Fundy, Canada

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Appendix 1. Method of calculating image areas of U/W photographs and video bitmaps to express hole and macrofaunal densities per metre squared

The height or *y*-axis of the image corresponds to the along track direction of TOWCAM and the width or *x*-axis corresponds to the cross-track distance. The following variables were used to derive the width (W) and height (H) of a pixel at the midpoint of the image and then the image area:

- A = height of camera above the sea floor in metres
- AR = vertical to horizontal aspect ratio of a pixel in the digitized image
- β = viewing angle in the vertical dimension of the image
- Θ = vehicle pitch angle + camera axis tilt
- φ = vehicle roll angle
- D_L = actual distance between laser points in metres
- X_L = projected distance between laser dots on sea floor in metres
- XP_L = distance between laser dots in pixels
- XP = width of total image in pixels
- YP = height of total image in pixels
- YP_L = distance from top of image to laser dots in pixels
- W = width of a single pixel at the midpoint of the image in metres
- H = height of a single pixel at the midpoint of the image in metres

Many image analysis softwares (e.g. Image Pro Plus) can be used to determine the pixel dimensions of the image as listed above. TOWCAM contains roll and pitch sensors and an altimeter (Gordon et al. 2006) which determine Θ, φ and A respectively. For the still camera, photographing a 0.5 m ring at various distances in water derived the angle β. Bradford (2005) derived it for video cameras by imaging a calibration grid in air then adjusting the result for the index of refraction difference in water.

If the sea floor is horizontal and flat over the image area then, with reference to Fig. A1:

$$\Phi = \frac{|[(YP/2) - YPL]|}{YP} \times \beta$$

$$A_1 = A/\cos(\Phi + \Theta)$$

Note: If the laser dots are below the midpoint of the image ($YP_L > YP/2$) then

$$A_1 = A/\cos(\Phi - \Theta)$$

In either case

$$A_2 = A/\cos(\Theta)$$

The distance between the laser dots on the sea floor (X_L) is a function of vehicle roll:

$$X_L = D_L / \cos(\varphi)$$

If the line between the laser dots subtends an angle Ω at the camera in the X direction then

$$\Omega/2 = \arctan[X_L/(2 \times A_1)]$$

and the equivalent distance between the laser dots when projected onto the midpoint of the image is

$$X_{LM} = 2 \times A_2 \times \tan(\Omega/2)$$

So the width of a single pixel at the midpoint of the image is:

$$W = X_{LM} / XP_L$$

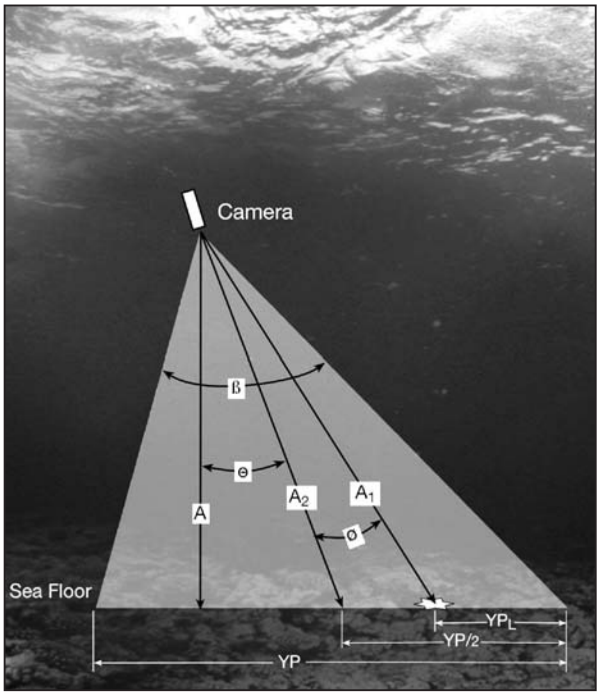
Now, if the camera is oriented vertically and the vertical to horizontal aspect ratio of a pixel is AR then the height dimension (H) of the pixel would be (W × AR). However, the camera is actually tilted forward by an angle Θ, thus

$$H = W \times AR / \cos(\Theta)$$

Finally, if the image is N_X by N_Y pixels then the area of the sea floor encompassed by the image is:

$$\text{Area} = (N_X \times W) \times (N_Y \times H)$$

Appendix 1 (continued)



LITERATURE CITED

Bradford JR (2005) TOWCAM system sensor-aided oblique-angle video mosaics. MEng thesis, University of New Brunswick, Fredericton

Gordon DC, McKeown DL, Steeves G, Vass WP, Bentham K, Chin-Yee M (2006) Canadian imaging and sampling technology for studying benthic habitat and biological communities. In: Todd BJ, Greene HG (eds) Characterization and mapping of sea floor conditions for benthic habitat delineation. Geol Assoc Canada Spec Publ 47: 29–37

Fig. 1. Angles used for the calculation of seafloor area covered by the camera view of the TOWCAM apparatus