# Photogrammetry SE 321
# Parallax-Height Relation
# Solved Problem

A pair of overlapping aerial vertical photographs were taken from a flying height of **1800m** above mean sea level (MSL) with a **150.00 mm** focal length camera. The air base was **900.00m** and x-photo coordinates of a point **q** on the left and right photos were recorded as **85.00mm and -05.00mm** respectively. **Parallax bar readings of 10.50, 15.20 and 10.00mm** were taken on image point **q, s and k**, respectively, compute the **levels** of ground points **Q**, **S and K**.
Also the **x and y** photo coordinates of points q and s on the left photograph were **$x_q$ = 85.00m, $y_q$ = 50.80mm, $x_s$= 90.00mm and $y_s$=-60.00mm,** Calculate the **horizontal ground distance between Q and S to the nearest cm**.

**Solution**
x-parallax of reference point q = x' –x" = 85.00 – (-05.00) = **90.00mm**
Parallax Bar Constant, C = x-parallax of q – parallax bar reading at q =
C = 90.00 – 10.50 = **79.50mm**
x-parallax of image s = C + parallax bar reading at s = 79.50 + 15.20 **= 94.70mm**
x-parallax of image k = C + parallax bar reading at k = 79.50 + 10.00 **= 89.50mm**

Use parallax-height formula to calculate height of point Q:

**$h_Q = H – B\,f / p_q$**

$h_Q$ = 1800.00 – [900.00 x 150.00 / 90.00] = **300.00m** above MSL

$\Delta h = h_I – h_Q = (H – Bf/p_i) – (H – Bf/p_q) = H – Bf/p_i – H + Bf/p_q$

$H_I – h_Q = Bf / p_q - Bf / p_i = Bf\,(p_i – p_q) / (p_i\,p_q) = B\,f\,\Delta p / [p_q\,(p_q + \Delta p)]$

**$h_I = h_Q + B\,f\,\Delta P / [p_q\,(P_q + \Delta P)]$; where $\Delta p = p_i – p_q$**

$h_S$ = 300.00 + [900 x 150 x (94.70 – 90.00) / (90.00 x 94.70) = 300 + 74.446
= **<u>374.446m</u>**

$h_K$ = 300.00 + [900 x 150 x (89.50 – 90.00) / (90.00 x 89.50) = 300.00 – 8.380
= **291.620m**

To calculate horizontal distance QS, determine ground coordinates of Q and S in a 2D coordinates system parallel to image coordinate system:

Ground coordinates of Q:

$X_Q = x_q (H – h_Q) / f = 85.00 (1800.00 - 300.00) / 150.00 = 850.00m$

$Y_Q = y_q (H – h_Q) / f = 50.80 (1800.00 - 300.00) / 150.00 = 508.00m$

$X_S = x_s (H – h_S) / f = 90.00 (1800.00 - 374.446) / 150.00 = 855.33m$

$Y_S = y_s (H – h_S) / f = 60.00 (1800.00 – 374.446) / 150.00 = 570.22m$

Ground distance $\mathbf{QS = [(X_S – X_Q)^2 + (Y_S – Y_Q)^2 ]^{1/2}}$

$= [(855.33 – 850.00)^2 + (570.22 – 508.00)^2]^{1/2}$

$=$ **62.45m**

**Exercise Problem**

A pair of overlapping aerial vertical photographs were taken from a flying height of **1800m** above mean sea level (MSL) with a **150.00 mm** focal length camera. The air base was **720.00m** and elevation of ground point **Q is 600.00m** above MSL. **Parallax bar readings of 10.50 and 15.20mm** were taken on image point **q and s** respectively, compute the **x-parallax** for image points **q and s** and **reduced level** of ground point **S.**