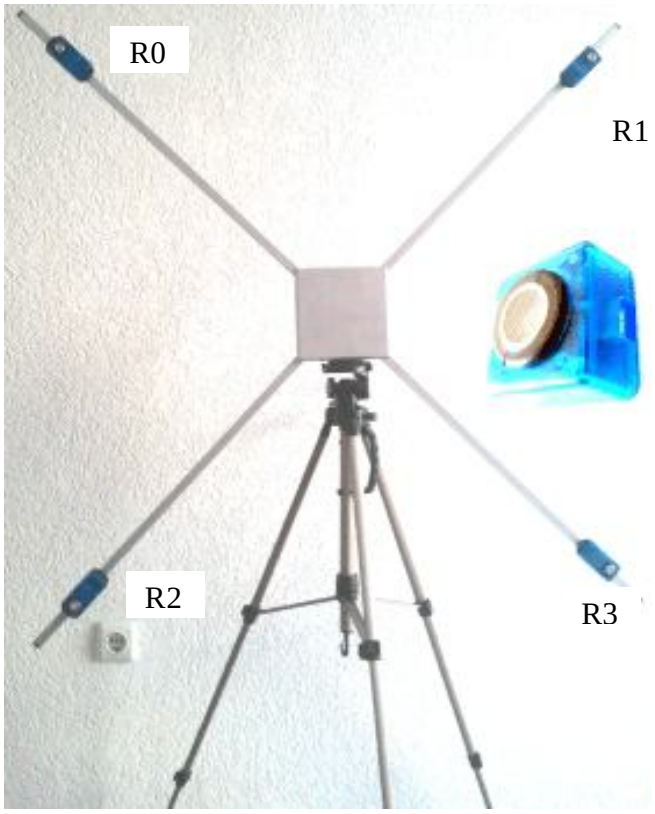
Consider the setup below, four receivers spaced equal distances apart. With respect to the rebol program provided with the hx19 package (hx19xyzV2.r); we need to set up our 3d frame in such way that the reference receiver is at the locus of the coordinate system at 0,0,0, the second receiver is located at 1,0,0 and the third at 0,1,0. For this simple approach, requirements are that at the end of each of the two axis there is one receiver, and one receiver located where the axes meet. It is also required that the angle between the axes be 90 degrees.

Below is a picture of the hx19eval pack II, it counts four receivers, but for the fundamental 3D frame only three receivers are used. For this example we have chosen R0 as the reference point at the locus of the axes. R1 is located at a unit distance from R0 on the X axis and similarly R2 is located on the Y axis a unit distance from R0. R3 is not used for this 3d frame.



Receiver 0 at (0,0,0) and Receiver 1 at (X_1,0,0) and Receiver 2 at (0,Y_2,0)

Given the above configuration, the following is true:

$$X = (R_0^2 - R_1^2 + X_1^2) / (2*X_1)$$

similarly

$$Y = (R_0^2 - R_2^2 + Y_2^2) / (2*Y_2)$$

and

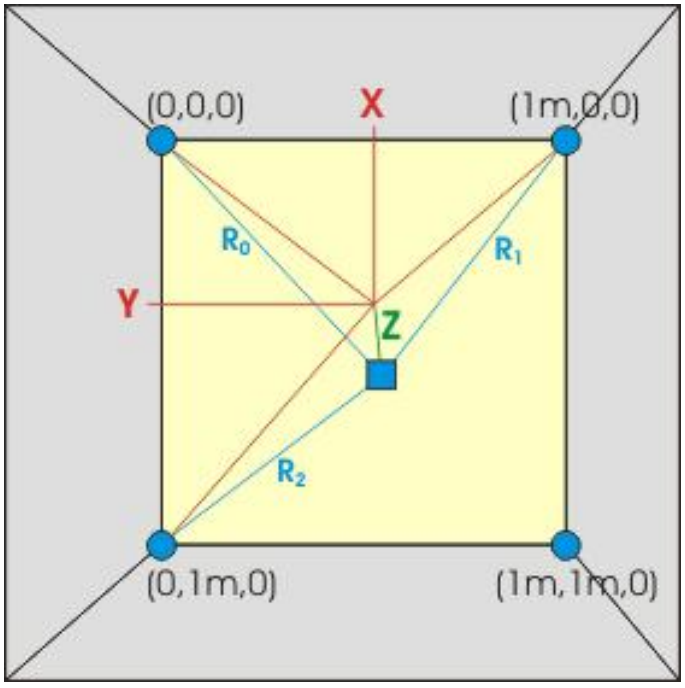
$$Z^2 = R_0^2 - X^2 - Y^2$$

Hx19 receiver 0 measures the distance R_0 to the tag as mm, similarly receiver 1 on the X axis returns its distance R_1 to the tag and finally on the Y axis receiver 2 returns tag distance R_2.

The rebol program uses 3 receivers with the lowest q enumeration for each acquisition cycle. It is possible to change the enumeration of any receiver using the q switch. For example the command set R3&q1, R2&q2 and R1&q3, would turn the frame on its head, R3 is the locus, R2 is the X axis, and R1 the Y axis. The hx19xyzDDE programs use a map file to compute the xyz coordinates, this takes computer time and significantly more complex math.

Example:

Let the receivers on the cross be 1m apart in the x and y direction (see illustration below). The green Z line is orthogonal on the yellow plane. The blue square represents the tag moving away and towards the yellow plane. Blue lines are the distances from tag to receivers (shown as blue circles at specific coordinate points). Blue line lengths is embedded in the serial string streaming from the receivers. Red lines are points on the yellow plane.



Let X_1=1m and Y_2=1m, then:

Receiver 0 at (0,0,0) and Receiver 1 at (1,0,0) and Receiver 2 at (0,1,0) then

$$X = (R_0^2 - R_1^2 + 1) / 2$$

$$Y = (R_0^2 - R_2^2 + 1) / 2$$

The Z position can be derived using a simple Pythagorean approach.

$$Z^2 = X^2 + Y^2$$

These equations take the unit distance to be 1, for this example 1m.

The above spatial arrangement makes the positioning math efficient, simple and within grasp of those who don't have time for elaboration. And it reduces processor load significantly, i.e. sets this operation within the realm of most Microcontrollers.

Hx19 measurement is in millimeters. The distances between receivers on the hx19xyzLab eval pack II cross is always 1000mm, so the axes should be in terms of mm instead of m.

The unit distance can be anything the user chooses, ft or inches, but the distance R (see the hx19demo.r) is always given in terms of mm. So it would be necessary to convert the distance given by each receiver into ft or inches should the user choose the imperial system.