Teacher's Guide

IMAGE Satellite Scale Model

Introduction

The construction of scale models of spacecraft has, historically, been an important engineering tool in designing spacecraft. Today, powerful 'CAD/CAM' software programs have become popular, but scale model building is still considered an important method of verifying satellite dimensions, tolerances and clearances.

Objective

The students will construct a scale model of the IMAGE satellite.

Procedure

1) Students will use the Spacecraft Dimensions Sheet to determine the scale model size. Note: When students are determining the diameter of the circle to construct the octagon, make sure that the measurement that is being used is from the opposite vertices.

2) Students will construct a pattern of the IMAGE satellite. They may opt to construct the pattern in a variety of ways; three methods are given below:

A—Students can inscribe an octagon using perpendicular and angle bisectors. Then they can cut the octagon out, and then use this to trace the second octagon. Students can create a rectangle using the corner of a sheet o paper, cut it out, and then trace the design seven more times. Students can then piece the design together using the tape.

B—The more advanced students may opt to determine how to construct the pattern in one piece. The students will need to determine the position on the paper to best fit the design. Students will then construct the design, cut it out, and then fold and tape it to complete the model.

C—Teachers may opt to use the included pattern. Cut out the satellite model, fold and tape it to complete the model.

3) Students can draw the IMAGE components on the model according to the Students Guid Sheet using the colored pencils.

Materials

—Compass

—Ruler

—8 1/2 x 11 paper

—Scissors

—Tape

—Spacecraft Dimensions

—Student Direction Guide

—Colored pencils

Conclusion

Scale model making is still an important tool for engineers and scientists to visualize how the various pieces of their spacecraft fit together.

Teacher Scaling Notes

The actual diameter for the NASA IMAGE satellite is 238 centimeters or 7.8 feet. The actual length of the rectangular side panels is 136 centimeters or 4.5 feet. The scale factor becomes 238 centimeters divided by 9 centimeters, which means that each centimeter on the diagram is equal to 26.4 centimeters on the actual IMAGE satellite.

The diameter of the Spacecraft Dimensions Sheet is 9 centimeters, which in turn makes the radius of the circle to be 4.5 centimeters. The width of the rectangle is 3.4 centimeters and the length is 5.1 centimeters. The length of the sides of the octagon will be 3.4 centimeters, the same as the width of the rectangular side panels.

NOTE!!!

Students may not be aware of the correct rectangle to measure. It would be hoped that the would realize that the width should be consistent with the length of the sides of the octagon. However, students may question why the top and the bottom rectangle 'look' different. Explain that this is due to the perspective of the drawing. When a side view of a three dimensional model is shown, the drawing tends to look distorted due to the perspective and the viewing angle.

Teacher, Pattern Construction Notes

1) With a compass, construct a circle with a 4.5 centimeter radius. Be sure to mark the center. Students should be aware that the sides of the octagon are 3.4 centimeters.

2) Use the ruler to draw a horizontal diameter.

3) Place the compass tip in the center of the circle. Open the compass a little and with the pencil end, mark an arc on both sides of the center of the circle.

4) Open the compass wider. (Note: If this step is forgotten, the marks will fail to cross.) From each of the arcs, swing the compass to make a large arc on both sides of the diameter. Where the two arcs cross is the point needed to draw the perpendicular diameter.

5) Draw the perpendicular diameter.

6) Place the compass point on the center mark. Construct a small concentric circle.

7) Using one of the angles created, open the compass wider, place the point on the spot where the new circle intersects the diameters. Swing the compass to create a semicircle. Place the point on the other diameter where the little circle meets, and construct another semicircle that intersects the previous one. Where the two semicircles meet will be two points. Connect the two points forming a new diameter. (Note: The new diameter will bisect the two angles.)

8) Repeat the process in Step 7 with the other two angles.

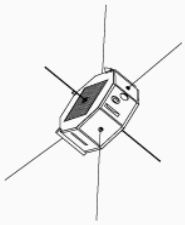
9) Connect the edges of the diameters drawn to construct the inscribed octagon.

10) Students will need to construct two octagons for the pattern.

Constructing the Rectangles

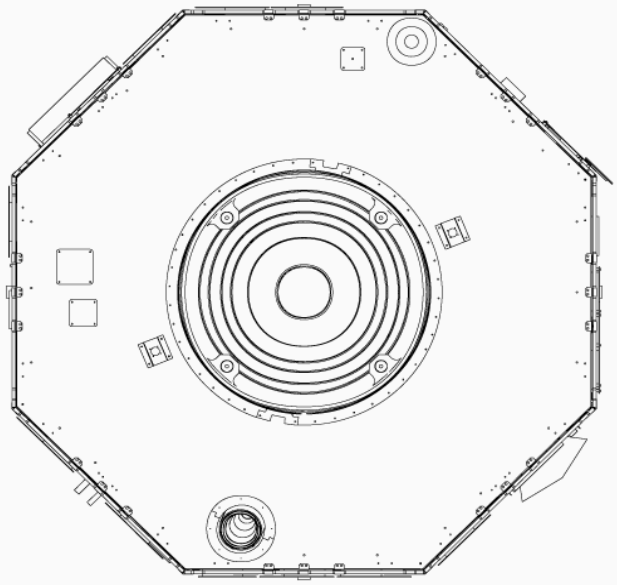
11) The eight rectangles need to be 3.4 centimeters by 5.1 centimeters .Some students may need to use the corner of a sheet of paper as the first two sides, and they can measure for the other two sides .The more advanced students can use perpendicular bisectors to construct parallel sides, and then they can do their measurements.

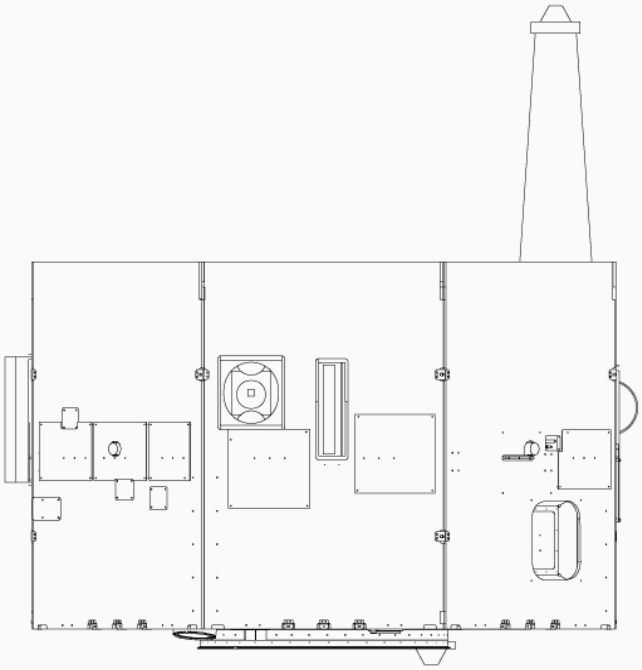
Note: If the pattern is being constructed entirely by hand, the given scale dimensions will fit on an 8 1/2 x 11 sheet of paper. The student will need to determine the lay-out of the the pattern.



IMAGE

Spacecraft Drawings





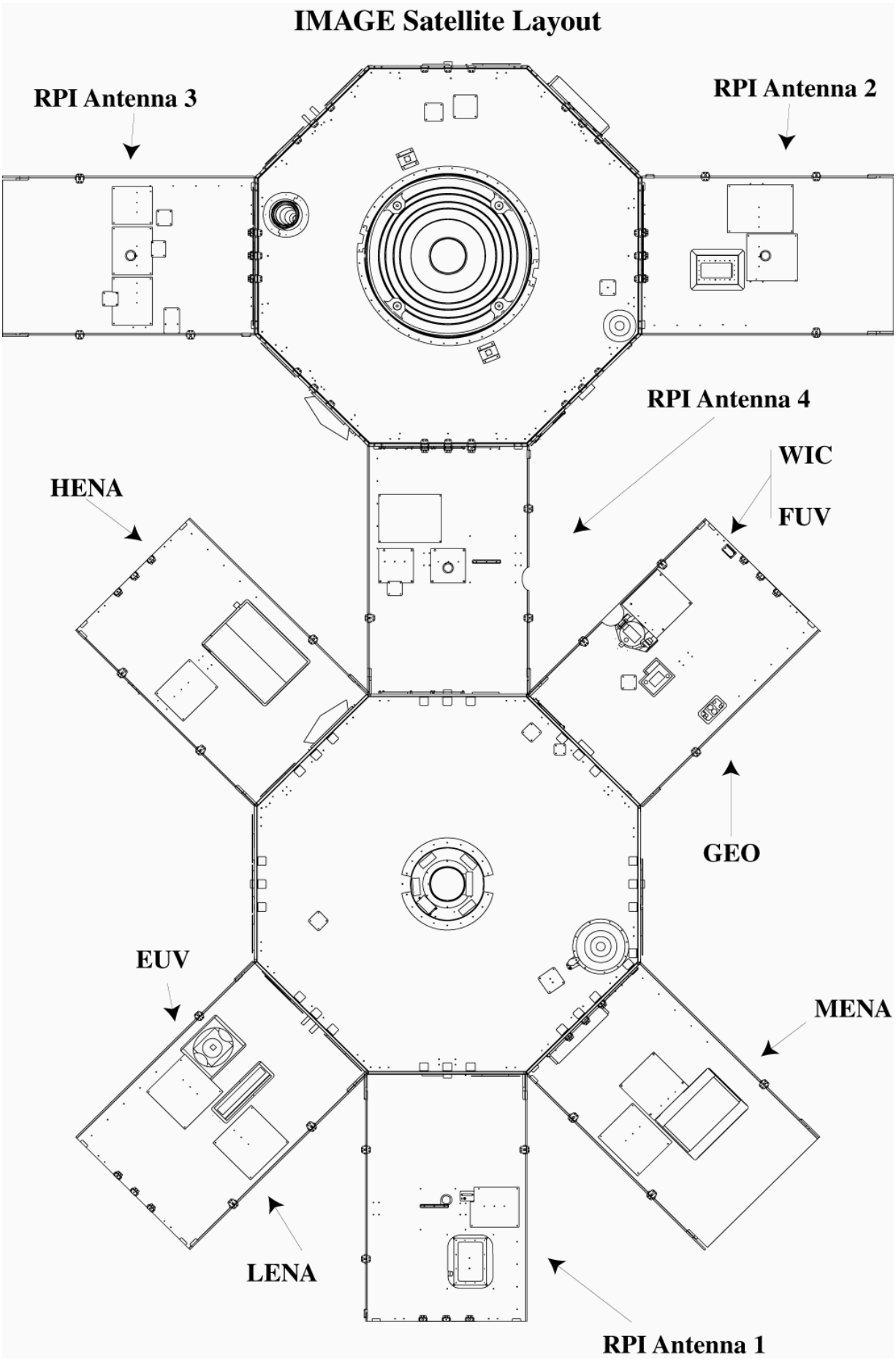


IMAGE Satellite Layout
RPI Antenna 3
RPI Antenna 2
RPI Antenna 4
WIC
FUV
HENA
GEO
EUV
MENA
LENA
RPI Antenna 1