SPINOFFS

Spinoffs are relatively short learning modules inspired by the LTAs. They can be easily implemented to support student learning in courses ranging from prealgebra through calculus. The Spinoffs typically give students an opportunity to use mathematics in a real world context.

LTA - SPINOFF 10A — Exploring how NASA's Automated Window Inspection Device (AWID) Uses the Rectangular Coordinate System to Track Defects

LTA - SPINOFF 10B — Analyzing the Cost Effectiveness of NASA's Automated Window Inspection Device (AWID)

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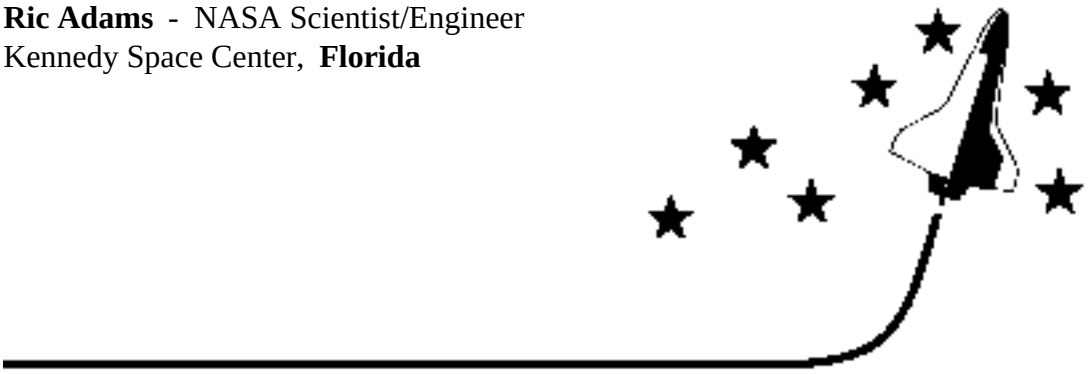

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SPINOFF 10A

Exploring How NASA's Automated Window Inspection Device (AWID) Uses the Rectangular Coordinate System to Track Defects

AWID and the Rectangular Coordinate System

NASA's Automated Window Inspection Device (AWID) locates defects on or below the surface of the Orbiter's windows by using a polarized light imager. Once the defects are identified, the AWID records their location using the rectangular coordinate system (Cartesian Plane). When starting the detection, AWID sets the origin at the top left hand corner of the window and proceeds to inspect the window in microscopic increments horizontally. Upon reaching the end of the window horizontally, it moves down one unit vertically and proceeds along this new horizontal path. This motion can be compared to the movement of a dot matrix printer that prints a line left to right then spaces down one line and prints the next line right to left. AWID continues in this fashion until the entire window has been inspected. Once the inspection is completed, the defects found by AWID are plotted. This plot allows questionable defects to be located easily by scientists who can perform further tests to determine if the window is safe for another mission or needs to be replaced.

Plotting Window Defects

1) Using graph paper, plot the following defect coordinates recorded by AWID. What is an appropriate scale for the x- and y- axis? (Remember that the origin corresponds to the top left hand corner of the window. Thus, in what quadrant will the points be located?)

A (0.231, – 0.14)	F (0.194, – 1.17)	K (0.012, – 0.021)
B (0.02, – 0.041)	G (0.092, – 0.013)	L (0.187, – 0.32)
C (0.184, – 0.92)	H (0.14, – 0.75)	M (0.171, – 0.53)
D (0.009, – 1.01)	I (0.051, – 1.18)	N (0.0135, – 0.008)
E (0.074, – 0.67)	J (0.234, – 0.148)	O (0.051, – 0.013)

Defects and Window Safety

2) In Exercise 1, you plotted the coordinates of defects found on an Orbiter window after the Orbiter returned from its most recent mission. Using the plot obtained in Exercise 1, analyze each scenario to determine if the window should be rejected or if it is safe for another Shuttle mission.

Scenario 1

The following are defects identified in a previous mission that were classified as not being able to withstand much more resistance: (0.34, – 1.19), (0.009, – 1.01), (0.194, – 1.17), (0.194, – 0.27) and (0.187, – 0.32). If three of the five points were hit again in this mission, then the window must be replaced.

Circle: SAFE or REJECT

Scenario 2

In a previous mission a defect was found that would be safe as long as no future defects occurred within the rectangular space formed by the following points: (0.70, – 0.5), (0.70, – 0.8), (0.085, – 0.5) and (0.085, – 0.8).

Circle: SAFE or REJECT

Scenario 3

The Defect A and Defect J were found to have caused major defects on the window. But it was determined that if the defects were at least 0.005 units apart the window would be safe for another Shuttle mission. (NOTE: What is the formula for finding the distance between two points?)

Circle: SAFE or REJECT

Scenario 4

Defects B, K and O were found to have caused major defects on the window. But it was determined that if any pair of the defects were at least 0.012 units apart the window would be safe for another Shuttle mission.

Circle: SAFE or REJECT

Scenario 5

If the area formed by a rectangle whose vertices include Defects G, I, and O is more than 0.05 square units then the window is safe enough for another Shuttle mission. (HINT: Find the other vertex of the rectangle then find the area of the rectangle)

Circle: SAFE or REJECT