"A REAL-LIFE APPLICATION OF RIEMANN SUMS"

Teacher Name

Date: MM/DD

M T W R F

Summary

The air speed above the fan is a function of position in three-dimensional space. Measurements using the anemometer at a particular height above the fan sample a two-dimensional slice of that function. The total air flow out of the fan is the definite integral of that slice over the surface of the fan (assuming the flow is perfectly vertical, which it's not exactly because of the spiral motion of the air). Dividing the fan's surface into a grid, measuring the air speed at each square in the grid, and summing the results constitutes an estimate of that integral (the flow) in the sense of a Riemann sum.

Estimate the total flow out of your box fan filter by sampling the air speed at regularly spaced points over the fan's output side. Multiply the air speed times the area of each square in the grid and sum the results to approximate the total flow rate (in cubic feet per minute).

Connection(s)

Previous Learning:

Riemann sums, (optional) double integrals.

Future Learning:

Divergence theorem: because there is no source of air molecules inside the Corsi-Rosenthal cube, the divergence is zero and therefore the flux integrated over the whole surface must equal zero. Measure the flux into each of the four filters and see if it is equal to that coming out of the fan.

Instructional Plan

(Note: WC…whole class; CL…cooperative learning structure; PR…cooperative learning pair; IND…individual work)

- Review Riemann sums and generalize to 2D if that's new — WC CL PR IND
- Estimate flow rate for the fan as a Riemann sum — WC CL PR IND
- Variation: try again with a smaller or larger grid size — WC CL PR IND
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Instructional Resource(s)

- Box fan filter
- Anemometer
- Ruler or tape measure
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