

Need(s) or Areas to Watch

- Evaluation – Top Level Metrics – Partnerships
- Website Development – More “Action” Documentation
- GLOBE Website – Data Visualization
- Science Activation Team Reach Map

Smoky Mountains STEM Collaborative

A DYNAMICAL ANALYSIS OF KITE FLIGHT

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Abstract

The mechanics of kite flying is a highly dynamic field of study due to the variability of one aspect versus the other. However, it is anticipated that a model of vertical kinematics may be achieved by taking data during a flight. Two teams were formed consisting of three people in order to fly a kite and gather data. Two identical kites were flown. A Kestrel Drop data logger was suspended from the line on each kite in order to collect data on temperature, relative humidity, wind stress index, air pressure, station pressure, and density altitude, all with respect to time. From this data actual altitude was derived as were graphs showing the relationships between altitude and temperature. Both groups were successful in deriving a kinematic relationship for flight as a third order polynomial.

Kinematics

The following equations were derived from the best fit line on the data to describe the position, velocity, acceleration, and jerk functions of each “best flight” for each kite team.

Kite 1

Altitude: $H(t) = 9.10E-07 t^3 - 0.2540 t^2 + 337.80 t - 7386.00$ (ft)

Velocity: $V(t) = 2.731E-06 t^3 - 0.5080 t + 337.80$ (ft/s)

Acc: $J(t) = 4.05E-05 t^2 - 1.0160 t + 0.0000$ (ft/s²)

Kite 2

Altitude: $H(t) = 1.07E-06 t^3 - 0.2210 t^2 + 337.80 t - 7386.00$ (ft)

Velocity: $V(t) = 3.21E-06 t^3 - 0.4420 t + 337.80$ (ft/s)

Acc: $J(t) = 6.42E-05 t^2 - 1.3240 t + 0.0000$ (ft/s²)

Future Plans

The Kestrel Drop proved to be a useful tool for collecting real time data about a kite’s flight. Future flights will require the other data available and look for relationships between altitude and relative humidity and altitude and air pressure.

The only drawback noted with the Kestrel Drop was the 2 second resolution on data collection. It is predicted a more rapid approach to data collection would result in a better kinematic model. The team plans to utilize Anemlys to design specific instrumentation that may yield results with higher resolution.

Equipment

The Kestrel Drop data logger was used to collect data on temperature, relative humidity, wind stress index, air pressure, station pressure, and density altitude, all with respect to time.

Analysis

The data was retrieved from the Kestrel drop data loggers attached to each kite, respectively. Altitude (vertical position) was calculated using the barometric pressure (in mHg) formula:

$$altitude = 1454.4 * (1 - \frac{pressure}{1013.25})^{0.19026}$$

Subtracting the altitude of the kite flying location from the altitude calculated above yielded the above ground level elevation (in ft). Plotting AGE vs. Time and including a line of best fit provided a function for position vs. time. In both cases, a cubic function was most accurate.

In the bottom two graphs, it was observed that as AGE elevation increased, temperature \downarrow decreased.

Kite 1 Data **Kite 2 Data**

Smoky Mountains STEM Collaborative Analysis of Kite Flight

Updates/Changes

- Website Updates
- Additions to “AREN User Community”
- Field Testing of Kites
- Monthly – Earthlings, NASA Headquarters, SciAct Working Group and AREN Team Monthly Online/Phone Conferences
- ROVER 8 Field Testing
- Published Podcast on Illuminating Food Webs: A Maker Jigsaw
- Partnership Meeting with the Michigan Science Center
- Workshop – Airborne Remote Sensing Seminar at UMES
- Continued Development of ARC GIS Map
- Development of an East Coast AREN Lending Library
- MapKnitter Field Testing
- Courses Underway at UMES – ENG 150 Wind Tunnel Research
- Meeting with GLOBE Partner – Paul Adams, Fort Hays State University

Cross - Collaboration

- Update Work with Mission Earth
- Meeting with Matt Cass from Smoky Mountain on poster submission
- Flying Practice in Alaska with Arctic and Earth SIGNs
- NISE Network was instrumental in setting up partnership meeting with the Michigan Science Center.

Look Ahead

- 2019 GLOBE Annual Meeting in Detroit, MI
- GLOBE AREN Field Experience
- GLOBE AREN Wind Speed Challenge

Results - Spring 2018

ENG 150 Wind Tunnels

