Integrating Computer Vision in AP Physics 1

UCF Center for Research in Computer Vision

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Objectives

Students will be:

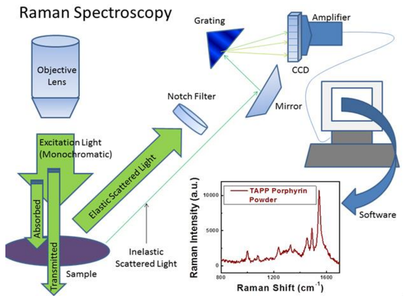
- able to apply physics concepts to real world situations.
- able to apply scientific method and experimental design to a modern physics technique.
- exposed to Computer Vision and Artificial Intelligence to understand the need for interdisciplinary collaborations and studies.

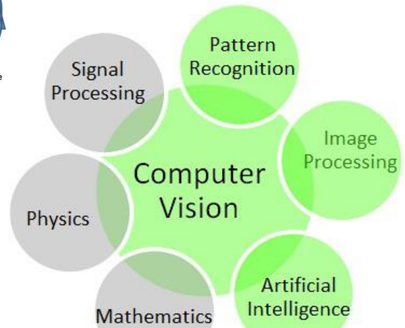
Standards

- **Science Practice 5** - The student can perform data analysis and evaluation of evidence.
  - **5.1** The student can analyze data to identify patterns or relationships
- **Big Idea 3:** The interactions of an object with other objects can be described by forces.
  - **3.A.2.1:** The student is able to represent forces in diagrams or mathematically using appropriately labeled vectors. **[SP 1.1]**
  - **3.A.3.1:** The student is able to analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object. **[SP 6.4, 7.2]**
  - **3.F.1.2:** The student is able to compare the torques on an object caused by various forces. **[SP 1.4]**
  - **3.F.1.5:** The student is able to calculate torques on a two-dimensional system in static equilibrium **[SP 1.4, 2.2]**

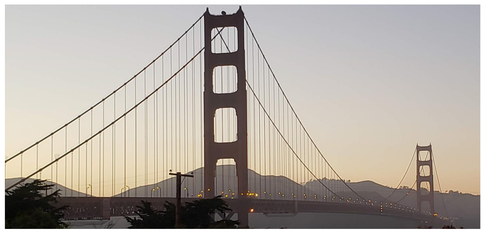
Educational Goals

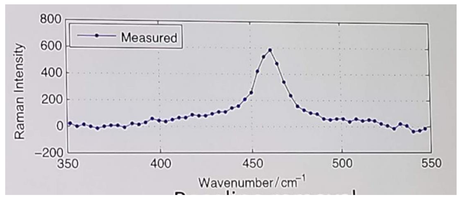
1. Expose students to real world applications of physics concepts regarding current problems.
2. Expand beyond the curriculum by introducing modern physics concepts and techniques being used to solve these problems.
3. Introduce students to the idea of interdisciplinary collaborations and generate interest in computer vision.











UCF Research

Problem: 1 in 9 bridges are structurally deficient and it will cost billions to monitor and bring bridges up to grade.

Research: UCF is using Raman Piezo spectroscopy to measure the amount of stress and strain on a micro level to propose a new infrastructure monitoring technique that is portable, fast, and non-invasive.

The Raman spectroscopy is being used in other areas, as well, for structural monitoring. Each material/chemical produces a unique Raman Shift, like a fingerprint, and can be used to identify materials or chemicals such as different types of rust.

References

1. American Society of Civil Engineers. (2017). *Bridges*. Retrieved from Infrastructure Report Card: https://www.infrastructurereportcard.org/

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Acknowledgements

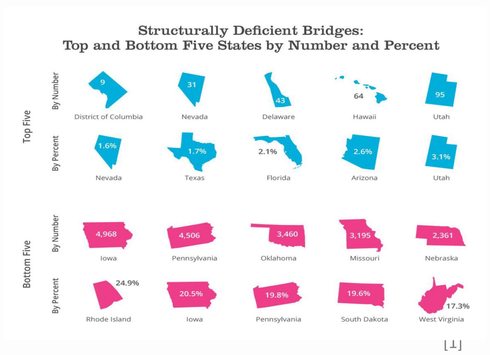
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Day 1

- **Bridges** – Build background knowledge about bridges with a physics tie-in to forces.
- **White board discussion** – Brainstorming in small groups about things to consider and monitor when building bridges.
- **Current Problems** – Discuss the state of America's infrastructure with examples of failed structures and places to improve.

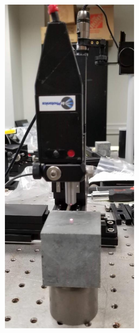


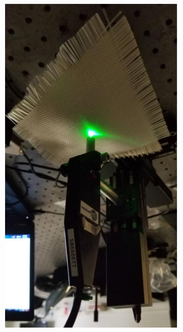


Day 2

- **Raman Spectroscopy** – Introduce a modern physics topic, Raman Scattering, and discuss how combining this phenomenon with new technology is being used at UCF to develop infrastructure monitoring techniques.
- **AP Physics FRQ** – Using new knowledge about Raman Spectroscopy, students will complete an AP type, experimental design, free response question. These type of questions account for 1 of 5 FRQs they will see on the AP exam.







Day 3

- **Computer Vision** – Challenge students with a task related to UCF Research with Raman Spectroscopy. Once completed, open discussion for ways to make things easier and faster using computers and computer vision.
- **Interdisciplinary Collaborations** – Expose students to computer vision and artificial intelligence applications in many disciplines to peak interest.
  - Introduce the idea of studying in, or collaborating with, multiple disciplines, like computer science in addition to physics or medicine.





