**Sources of documents used in the short course**

Please notify Vince Cronin (Vince\_Cronin@baylor.edu or via ece@unavco.org) if any of the

links listed below are no longer operable. Revised 23 August 2015

UNAVCO educational resources

<http://www.unavco.org/education/resources/educational-resources/educational-resources.html>

Infinitesimal strain analysis using GPS data: Module for a structural geology or geophysics course

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/majors-gps-strain.html>

PBO state-of-health map

<http://pbo.unavco.org/network/soh_map>

PBO network map

<http://www.unavco.org/instrumentation/networks/status/pbo>

Resources Cronin has developed for this project

[http://CroninProjects.org/Vince/Geodesy/](http://bearspace.baylor.edu/Vince_Cronin/www/PBO_ed/)

**Introductory Material**

Part 1 of short course presentation: introduction through "physical models of strain"

<http://CroninProjects.org/Vince/Geodesy/ShortCrse19June2014_1.ppt>

Part 2 of short course presentation: GPS basics

<http://CroninProjects.org/Vince/Geodesy/ShortCrse19June2014_2.ppt>

Part 3 of short course presentation: Introduction to the triangle strain problem using GPS velocity data

<http://CroninProjects.org/Vince/Geodesy/ShortCrse19June2014_3.ppt>

Part 4 of short course presentation: Finding the input data on UNAVCO's PBO site-summary pages

<http://CroninProjects.org/Vince/Geodesy/ShortCrse19June2014_4.ppt>

Part 5 of short course presentation: Example from north Lake Tahoe-Truckee area

<http://CroninProjects.org/Vince/Geodesy/ShortCrse19June2014_5.ppt>

Resor et al., 2012, Using Earthscope Plate Boundary Observatory GPS velocities to introduce strain to undergraduate structural geology students. GSA annual meeting, 2012

<http://CroninProjects.org/Vince/Geodesy/ResorEtAl2012.ppt>

Physical models of strain

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/physical-models-of-strain.pdf>

Worksheet: 1-D Extension/Elongation of a Bungee Cord

<http://CroninProjects.org/Vince/Geodesy/ExtensionWorksheet.doc>

PowerPoint slide resources for 1-D extension/elongation of elastic cords. (Not a coherent presentation; intended just to give you some PPT slides to mine)

<http://CroninProjects.org/Vince/Geodesy/1D-ext-slides.ppt>

Strain -- for students

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/strain-intro-for-majors-student.pdf>

Strain -- for instructors

[http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/ module-materials/strain-intro-for-majors-instructor.pdf](http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/%20module-materials/strain-intro-for-majors-instructor.pdf)

**Learning about GPS and PBO**

PowerPoint: Introduction to GPS basics

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/intro-to-gps-presentation-instructor.pptx>

Using velocities from a triangle of GPS sites to investigate crustal strain

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/using-velocities-from-gps-station-triangle-to-investigate-strain-instructor.pptx>

Finding location and velocity data for PBO GPS stations

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/finding-gps-data-cascadia-student.pdf>

PBO velocity data worksheet for triangle-strain projects

<http://CroninProjects.org/Vince/Geodesy/PBOWorksheet14.doc>

Excel calculator: strain within a triangle of GPS sites

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/gps-triangle-strain-calculator.xlsx>

MatLab calculator: strain within a triangle of GPS sites

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/calcstrain.m>

Mathematica calculator: strain within a triangle of GPS sites

<http://CroninProjects.org/Vince/Geodesy/TriangleStrainCalculator.nb>

Explanation of strain calculator output data

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/explanation-of-calculator-output.pdf>

Slides showing a triangle-strain analysis in Cascadia

<http://CroninProjects.org/Vince/Geodesy/CascadiaSlides.pptx>

**Student Projects**

Homework sign-up sheet (based on 5 great examples of PBO triplets)

<http://CroninProjects.org/Vince/Geodesy/GPStriangleHWsignup.doc>

GPS strain analysis -- instructor notes with included student exercises

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/gps-strain-analysis-examples-instructor-and-student.pdf>

Cronin's GPS triangle-strain project, used in an introductory structural geology course

<http://CroninProjects.org/Vince/Geodesy/GPS-ProjDescr-2014.docx>

Cronin's GPS triangle-strain project, evaluation rubric (created by Beth Pratt-Sitaula)

<http://CroninProjects.org/Vince/Geodesy/Rubric13.docx>

Geodesy and strain -- calculating and mapping incremental strain with GPS data (Anne Egger's class project)

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/san-andreas-gps-strain-activity-eggers.pdf>

**Background**

Primer on infinitesimal strain analysis in 1, 2 and 3-D

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/infinitesimal-strain-primer-and-gps.docx>

Algorithm for computing infinitesimal strain rate between three non-colinear GPS stations, given their N-S and E-W velocities, with a worked example

<http://www.unavco.org/education/resources/educational-resources/lesson/majors-gps-strain/module-materials/algorithm-for-gps-triangle-strain.docx>

**Mathematical Refreshers**

Vectors and vector arithmetic

<http://CroninProjects.org/Vince/Geodesy/VectorSummary30Aug2012.docx>

Vector worksheet

<http://CroninProjects.org/Vince/Geodesy/VectorWorksheet.docx>

Matrices

<http://CroninProjects.org/Vince/Geodesy/Matrices.doc>

Worksheet on vector dot products and simple matrix mathematics

[http://CroninProjects.org/Vince/Geodesy/DotProd&MatrixWorksheet.docx](http://CroninProjects.org/Vince/Geodesy/DotProd%26MatrixWorksheet.docx)

How to find the eigenvalues and eigenvectors of a symmetric 2x2 matrix

<http://CroninProjects.org/Vince/Geodesy/FindingEigenvectors.doc> or

<http://CroninProjects.org/Vince/Geodesy/FindingEigenvectors.pdf>

Orthogonal transformation of cartesian coordinates in 2D & 3D

<http://CroninProjects.org/Vince/Geodesy/OrthogonalCoordTrans.doc>