

FO-4311/6311 Spatial Technologies Laboratory 5 & 6  
**5. & 6. Planimetric Mapping Concepts**

The objectives of this laboratory exercise are to teach students to:

1. Utilize aerial photographic information and primary control points to prepare a planimetric base map,
2. Establish supplementary control points by radial triangulation,
3. Delineate forest cover classes on aerial photos, and
4. Transfer feature detail from aerial photos to the planimetric base map with a vertical sketchmaster.

### **I. Preparation of Photos and Base Map**

Locate, prick, and ink (with 0.2 inch diameter circle) the principal (red) and conjugate principal (black) points on the mylar cover of the center photo of the stereo triplicate. Do not damage the photos!

The paper used to construct the base map should be about 20 by 20 inches in size and reasonably thick. The top of the map will be oriented North.

The primary control points (PCPs) listed below are UTM NAD27 coordinates in meters, and must be plotted on the base map at a **scale of 1/36,000**. Check your calculations and measurements. Connect the diagonals to locate the center of the base map sheet. Determine the UTM coordinates of an "identifiable center" (i.e road intersection, stream across highway, etc.) of your photo mapping area (i.e. .75 inch border around stereo pair) from the Bluff Lake or Bradley quad sheet.

To determine primary control point UTM coordinates, connect the UTM tick marks on both sides of the quad sheet for the easting and on both top and bottom ticks for northing coordinates. Use the 60th scale to determine the x,y (i.e. easting, northing) distances in meters from the known UTM coordinate to the control point.

All control points should be referenced to the center point of the base map. **Locate at least 8 control points; the 4 corners and midpoints along each side.** Locate/plot the primary control points on the base map and on the center photo of the stereo triplicate, only.

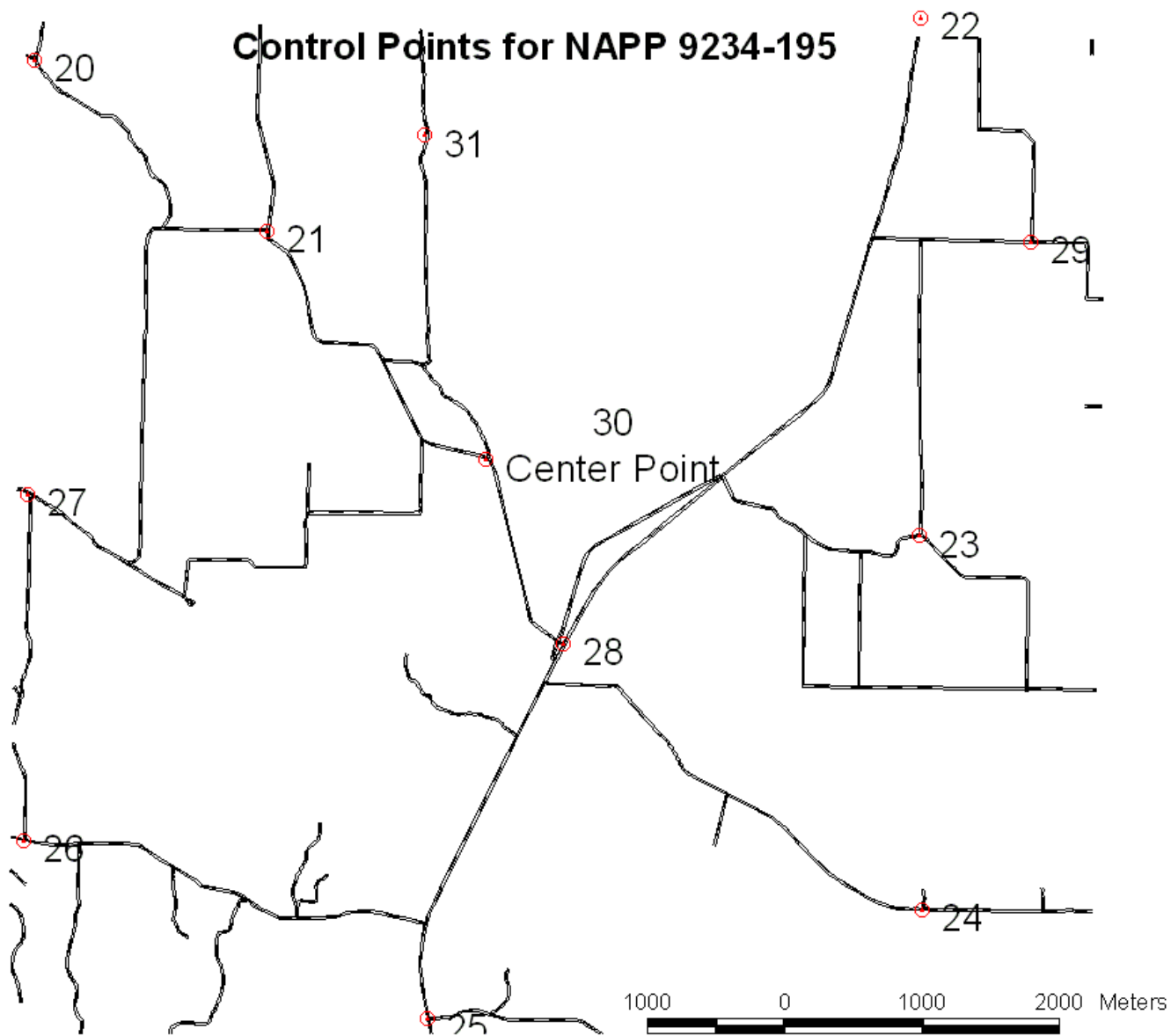
#### Primary Control Point Coordinates & Description

The UTM coordinates (NAD 27) of known control points are listed below and depicted on the attached sketch.

**NAD27 Primary Control Points for NAPP 9234-195**

Control Point #	Easting	Northing
20	319,474.72	3,693,793.50
21	321,168.09	3,692,546.50
22	325,911.30	3,694,095.75
23	325,903.78	3,690,333.25
24	325,916.49	3,687,610.51
25	322,328.72	3,686,814.75
26	319,396.25	3,688,115.12
27	319,420.94	3,690,635.25
28	323,312.72	3,689,545.50
29	326,712.50	3,692,464.50
30	322,759.27	3,690,885.49
31	322,322.40	3,693,241.77

These primary control points will be used to control a planimetric map of the area covered by photos 9234-194,195,196. After locating the points on photo 195, they should be pricked and circled (0.2 inch diameter) in a different colored ink from either the principal (red) or conjugate principal (black) points. Check and double check your locations before you permanently mark them. Prick and circle the control points on the mylar overlays, not on the photos!



## Plotting Primary Control Points on Base Map

Use a point closest to the center of your mapping area as the origin.

Pencil the X and Y axis lightly on the base map such that the X-Y axis crosses at the center of the base map. Use diagonal lines from the base map corners to determine the geometric center of the mapping surface.

For this exercise, use 322,759.27mE and 3,690,885.49mN as the center of the base map.

base map scale:      R.F. = 1:36,000      1" = 3,000 ft.  
60/60" = 914.4 meters or 1/60" = 15.24 meters

base map origin =      322,759.27m E      3,690,885.49m N      Zone 16N

Control point 21:      321,168.09m E      3,692,546.50m N

Control point 28:      323,312.72m E      3,689,545.50m N

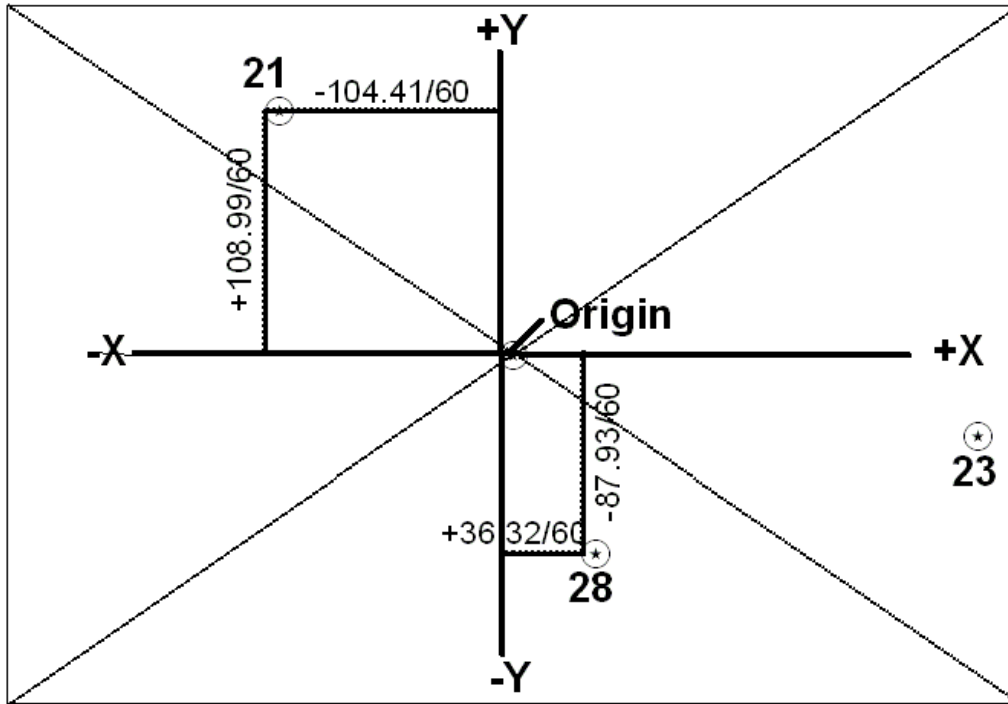
Determining the X & Y distances of control points from origin:

21:    X=easting = 321,168.09 - 322,759.27 = - 1,591.18m = -104.41/60ths  
      Y=northing= 3,692,546.50 - 3,690,885.49 = + 1,661.01m = +108.99/60ths

28:    X=easting = 323,312.72 - 322,759.27 = + 553.45m = + 36.32/60ths  
      Y=northing= 3,689,545.50 - 3,690,885.49 = -1,339.99m = - 87.93/60ths

See Figure below for base map plotting of primary control points.

# Plotting Control Points on Base Map



## **Entering and Plotting Control Points with Arc View 3.2**

1. Enter the control points in an Excel spread sheet with the columns of  
Point#            Easting            Northing
2. Export the table out as a comma delimited text file or dbf file.  
Hint: describe coordinate and datum in name; e.g. 195control\_Nad27\_utm
3. In Arc View:
  4. Open a new project
  5. Open a new view then close view with upper right x
  6. Table....add... define table type as txt or dbf or \*.csv
  7. Under View .... Add Event Theme
    8. Specify X= easting, Y= northing
  9. Activate theme; e.g. click on theme title to activate the “box”
  10. Under Theme tab.....Convert to shape file...save in desired directory...display on view
11. Re-project shape file of control points to desired coordinate and datum with the Projection Utility in Arc View or with PCGPS 3.7
  12. In PCGPS 3.7, bring in the shape file (specify SHP as type), specify the current coordinate and datum
    13. Switch coordinate and datum as desired...under Map...coordinate system
    14. Export out a SHP file...change name to reflect new coordinate and datum  
e.g. 195control\_WGS84\_utm
  13. In Arc View, use the Projection Utility under the File tab
14. To plot the control points at a specified scale:
  - a. create a Layout
  - b. bring in the view at “user specified scale”; e.g. 1:36000
  - c. display the layout; adjust the “view” to move the view around the layout screen area if the desired scale only prints a portion of the view in the layout window.
  - d. print to printer

## II. Transfer of Principal and Conjugate Principal Points to Base Map

### Radial Line Triangulation

The procedure for transferring CP's to the base map is based on the **radial line assumption**: Assuming vertical or nearly vertical photos, true horizontal angles can be measured from the principal point because scale change and relief distortions are radial from the principal point. That is, the horizontal angle, measured from the principal point, remains the same even though the object points shift along the radial line.

Once the PP and CPP points have been located on the photos and the CP points have been plotted to scale on the base map, you can use a radial line plot procedure to transfer the angles to the points to the base map.

Tracing Paper Templet or graphical method is very inexpensive and is the most accurate of readily available methods commonly used in forestry work. A paper templet (tracing paper) is placed over each of the photos and a series of lines, radiating from the principal point, is drawn from the principal point across each CPP, PCP, and SCP. Each line is labeled. Each templet is then placed on the base map and adjusted until the labeled, radiating lines cross the PCP's. When all templets are in place, the intersection of the crossing, radial lines is pricked and labeled. Three intersecting lines establishes a PCP on the base map.

**Use the tracing paper templet method to transfer the principal points from the stereo overlap area (i.e. one principal point from each photo of the stereo pair) to the base map.**

## III. Delineation of Forest and Land Use Classes

After the radial transfer, the photos should be stand mapped with a grease pencil. At the scale and for this season of the year, you'll not be able to discriminate anything within the forest cover class of "hardwoods". You can, however, indicate differentiate between upland or bottomland hardwoods. The following species and size classes should be mapped:

<u>Species Classes</u>	<u>Size Classes</u>	<u>Non-Forest Classes</u>
1. upland hardwoods	1. reproduction	1. Agriculture - pasture, row crops
2. bottomland hardwoods	2. pulpwood/pole	2. Structures - houses, barns, etc.
3. natural pine	3. sawtimber	
4. planted pine	4. cut-over	
5. mixed stands		

If possible, you should also recognize density classes in the pine as sparse, normal, dense.

Other cover and land use classes to be recognized include:

Agriculture-- row crops, pasture  
Structures-- houses/buildings, barns

Other Cultural features and any other land classes of importance to forest management activities.

#### **IV. Transfer of Feature Detail**

Each person in the crew shall transfer detail from at least a portion of one photo to the map using the vertical sketchmaster. The three legs of the sketchmaster can be adjusted to provide the correction necessary to match the photo image to the corresponding map points. DISTRIBUTE residual error. In any event, make sure that the PCP's are on, with residual error distributed equally among the SCP's. When all detail has been transferred, clean up the base map and do not forget to add all the necessary annotations to convert it from a piece of paper to a proper cartographic map.

#### **V. Submittals**

1. Forest types on the stereo overlap portion only.
2. Do not map any roads or streams.
3. Prepare "draft" cartographic map; i.e. map contains all elements of a finished map such as title, scale, north arrow, legend, border, etc. but the map may contain pencil lines and other notations.
4. Submit mylar overlay and grade sheet stapled together(flat) with flat map (not rolled) with name on outside edge for identification. DO NOT submit the aerial photograph.

Note: Roads and streams will not be mapped in this exercise. Only vegetation and land uses will be mapped.

**Spatial Technologies Mapping Project  
Laboratory Exercise 05/06**

Names: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Grade: \_\_\_\_/70

**Required Submissions:**

1. Flat, not rolled, Map
2. Milar overlay of types delineations
3. Copy of this grade sheet stapled to map and mylar overlay.

**On Mylar Overlay**

Possible    Earned

1. PP and CPP located and inked.....	5	_____
2. Control points located and inked .....	5	_____
3. Forest species types delineated on photo .....	5	_____
4. Forest size-classes delineated on photo .....	5	_____

**On Base Map**

5. Control points inked .....	5	_____
Principal points inked .....	2	_____
6. Types transferred from stereo area .....	5	_____
7. Type symbols within types .....	5	_____
8. Proper title (what, where, when, how).....	6	_____
9. Scale labeled (RF and graphic).....	6	_____
10. North arrow drawn .....	5	_____
11. Legend of symbols used: features .....	4	_____
:types & size classes..	2	_____

**Overall Map Appearance** .....10 \_\_\_\_\_

**TOTAL POINTS** **70** \_\_\_\_\_

## Presentation of Maps

A. Map Features: The purpose of the map and the notations and measurements of land and/or vegetative cover will determine the features that are to be plotted within the border of the map proper. The essential items always included on any map are:

- |                                |           |
|--------------------------------|-----------|
| 1. Title                       | 4. Legend |
| 2. Scale                       | 5. Border |
| 3. North and/or magnetic arrow | 6. Margin |

B. Title: The map title is as important as the plotted symbols or features. Without a correct and complete title, the map cannot be readily used. A poorly designed or executed title may ruin the appearance of the finished map. The title should appear at the top area of the map, but can be placed on one side or the other; it does not have to be centered. Each line of the title is centered about the vertical axis of the title block. The map title should contain the following items:

1. Kind of drawing or depiction - Topographic Map, Timber Stand Map, Boundary Survey Plat, Ownership Map, etc.
2. How map was prepared - transit and stadia survey, hand compass and pacing, staff compass and chain, etc.
3. Location or descriptive name(s) of map area - John Starr Memorial Forest, Cypress Creek Unit, Holiday Lake Recreational Area, etc.
4. Purpose (optional; if special features are shown) - Proposed Timber Sale, Forest Fuel Types, etc.
5. For whom map was drawn or area ownership - Willamette Industries, Inc., Tennessee Woodlands Division; Georgia Pacific Corporation; etc.
6. Location of mapped area - Township, range, section, county, state, etc.

The following items are elements of the title but may not appear in the title block, proper:

7. Scale - scale should be given in words (1 inch = 20 chains), fractional (1/15,840), proportional (1:15,840), and/or graphic bar format. The scale should include the horizontal and vertical scales.
8. By whom the map was prepared - cartographer's name, company name, etc.

9. Date of map preparation - month, day, and year.

C. Sample Map Title:

Forest Stand Map  
of

CYPRESS CREEK UNIT  
John Starr Memorial Forest  
Oktibbeha County, Mississippi

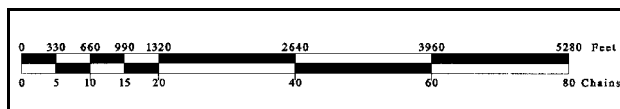
Prepared from:  
1:24,000 USDA Aerial Photography, 1992  
and  
Hand Compass and Pacing Survey

by:  
F0-3514 Crew Number 5  
(names)  
MSU Department of Forestry

May 8, 1994

D. Scale: The map's horizontal scale should be indicated in at least 2 different ways; words over a graphic bar, or proportional over a graphic bar, etc.. The vertical scale is usually given in words as part of the title, or may appear below the horizontal scale.

1. equivalent/word scale - 1 inch = 20 chains, 1 inch = 4 miles, etc.
2. representative fraction/proportion - 1:15,850, 1:7,925, etc.
3. fractional scale - 1/15,840, 1/7,925, etc.
4. graphic bar scale -



5. vertical scale - Contour Interval: 10 feet

E. North and/or Magnetic Arrows: All maps should have an arrow indicating the direction of true north. The true north arrow is shown with a full arrow; i.e. a full point and tail. If a magnetic arrow is shown, the half-magnetic arrow is set off from the north arrow the amount of the declination and in the proper declination. If the map depicts an area that is west of the agonic line (line of zero declination that runs through the Georgia), the magnetic arrowhead is shown on the east side of true north; i.e. east declination. West declinations are shown on the west side of true north. The amount of declination and the date of the survey/map should be shown below the magnetic arrow.

The north arrow, and/or magnetic arrow, should be proportional to the size of the map and should be centered above the map title or placed to one side, preferably in the top portion of the map.

- F. Legend: The legend explains symbols used on the map. If only standard cartographic symbols are used, a legend is not necessary unless the user is unfamiliar with the standard set. Non-standard symbols should always be shown in the legend.

The legend should be placed so that it presents a harmonious balance between itself, the title, the graphic scale, the north arrow, and the body of the map. It should not appear above the title. All symbols within the legend should be placed in vertical columns, grouped according to their similarities, and listed in order of descending importance. The second column should state the interpretation of each symbol, expressed in brief but accurate terms. Symbols in the legend must be exact reproductions of the symbols used on the map for size, detail, and color/shading.

- G. Border: A suitable border should encompass all maps. No map feature may appear beyond the limits of the border. The map title, north arrow, scale, and legend are balanced around the map within the border. An acceptable border system involves an inked strip 0.1 inches wide set in 0.5 inches from the edge of the paper with a single inked line less than 0.05 inches wide placed 0.2 inches inside the inked strip. All corners of the border should form right angles and should be neat.
- H. Margin: The margin is clean, with white paper surrounding all features found on the map. The width of the margin is arbitrary, but the four margins widths should be equal.
- I. Standard Cartographic Symbols: A copy of standard symbols can be obtained from the Map Information Office, Geological Survey, Department of the Interior, Washington, D.C. 20242.

### **Reference**

Parker, R. C. 1972. Preparation of Finished Maps for Use in Forestry. Cooperative Extension Service Publication 466, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061