UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF SURVEYING

29.005 SURVEYING V

FIELD EXERCISE: DETERMINATION OF CYCLIC ERROR AND ERROR POINTING DIAGRAMS

1. AIM

To familiarize students with the method of determining cyclic errors and the phenomenon of phase inhomogenities in the transmitted beam.

2. INTRODUCTION

The cyclic error of an EDM instrument is produced by electrical and optical crosstalk between transmitter and receiver. The wave length of a possible cyclic error is 10m exactly for HP 3800B, HP 3805A, KERN DM 501 and AGA geodimeter 14 instruments. Phase inhomogenities in the transmitted beam are mainly caused by the phase of the transmitted signal not being constant across the active surface of the emitting diode.

3. EQUIPMENT

Per 2 groups:

1 30m Steel Tape "Lufkin"
1 5kg Weight (from tape standardization set)
1 Length of String
1 Spring Balance (with hook)
1 Quantity of Rags

Per Group:

1 EDM Instrument Hewlett-Packard HP 3800B or HP 3805A with:

- 1 Battery Pack (charged) plus cables
- 1 Wild Tribrach GDF 6
- 1 Transmitter Lens Attenuator Cap

1 Single-prism AGA or HP Reflector (old) with:

- 1 Tribrach Wild GDF 6
- 1 Revolving Swivel Base
- 1 Red and White Target (as long as available)

2 WILD Tripods GST 20
1 Barometer(small survey aneroid "Dobbie")
1 Thermometer
1 Umbrella with Steel Base
1 Hammer
1 Pocket Tape (3m)
1 Folding and Wooden Levelling Staff
1 Clip Board
2 Ranging Rods

OR:

1 EDM Instrument KERN DM 501 with:

1 Battery Pack plus Cables

1 Theodolite KERN K 1SE
1 KERN Centring Tripod (orange)
1 Single KERN Reflector with Base and All Weather Cover
1 Barometer (small survey aneroid "Dobbie")
1 Thermometer
1 Umbrella with Steel Base
1 Hammer
1 Pocket Tape (3m)
1 KERN Reflector Tripod comprising One Reflector Road and Two Adjustable Struts
1 WILD GDF 6 Tribrach
1 Adaptor Set Fitting KERN Reflector onto Wild Tribrach
1 Clip Board

OR:

1 EDM Instrument AGA Geodimeter 14 with:

1 Battery Unit and Cable
1 Attenuator Cap

1 WILD Theodolite T2 with Geodimeter Adaptor
2 Wild Tripods GST 20
1 Tiltable AGA Target with One Single Prism in the Centre and with:

1 Adaptor to WILD Tribrach
1 WILD Tribrach GDF 6

1 Barometer (small survey aneroid "Dobbie")
1 Thermometer
1 Umbrella with Steel Base
1 Hammer
1 Pocket Tape (3m)
1 Clip Board

4. FIRST PART OF EXERCISE

Note: Two groups are sharing one cyclic error test line. Therefore, one group starts with part 1, the other one with part 2 of the exercise.

4.1 The method used to determine the cyclic error of an EDM instrument is explained in section 4.62 of "Introduction to Electronic Distance Measurement" by J.M. Rüeger. Testlines are located as follows:

(1) From a peg on the bank to the S/W of the GAS Building to the top of the wall of the Undercroft of the M.E. Building.

(2) From an iron bolt close to the East wall of the GAS Building to the top of the bench on the East side of the M.E. Building.

(3) From a peg off the road which runs between the Main Building and the Architecture Building to a concrete slab on the sector shaped theatre in the Main Building, opposite Architecture Building.

The exact locations of the lines will be indicated by your demonstrator.

4.2 Hook the 30m tape over the edge being close to the instrument station and lay the tape along the top of the "wall". Attach the spring balance and the 5kg weight to the tape on the other side of the "wall". Use rag to pad the tape as it passes over the sharp edge of the "wall".

4.3 Set up EDM instrument over the mark at such a height that the EDM wave path will be parallel to the 30m tape on the "wall".

The axis of the tape intersects the plumb line through the instrument station mark at the following height:

Line (1) Peg A: 1.38m Peg B: 1.60m

Line (2) Peg A: 1.147 m

Line (3) Peg A: 1.160 m

Line (4) Peg A: 1.384 m

4.4 Shade instrument with umbrella and fix thermometer in shade at height of instrument.

4.5 Set front edge of reflector tribrach at 0.25m on the tape. Point EDM to reflector and obtain maximum signal strength. Note aiming point and use this point for subsequent measurements. Measure the distance twice,+temperature and pressure. With the AGA geodimeter 14, the accuracy knob has to be used and the first measurement is done on position Ph. 1, the second one on Ph. 2.

With the KERN DM 501 however, the pointing is always done optically (through the telescope of the theodolite) to the centre of the prism. Do never use maximum signal strength for pointing with the DM 501.

4.6 Measure distances at 0.25m intervals to the 10.25m graduation on the tape.

Note the time of each measurement. Point optically to the aiming point determined in 4.5 with HP 3800B, HP 3805A, or AGA 14 instruments, or to the centre of the reflector with KERN DM 501.

4.7 Measure temperature and pressure periodically throughout the exercise. (The complete set of measurements takes approximately 1 hour.)

4.8 Use attenuator caps where appropriate for the particular instrument and set environmental correction dials to zero.

4.9 Record general weather conditions.

5. SECOND PART OF EXERCISE

5.1 Set up instrument somewhere in the lawn between Main Building and Barker Street. Shade by umbrella.

5.2 Set up reflector 20m apart, either on a tripod (HP, AGA instruments) or a reflector tripod (KERN instrument).

5.3 With AGA or KERN instrument: Point optically to the centre of the target. Orientate horizontal circle of theodolite to get an exact degree reading. Book it. Turn theodolite in 1' steps to the right, every time measuring twice the distance and recording angle, distance and signal strength on field form. If no further measurement is possible, point again to the centre of the target and repeat procedure to the left. Re-measure again centre position at the end.

With HP 3800B or HP 3805A: Span pocket tape horizontally between 2 ranging rods, perpendicular to the line of sight and below the prism. Point optically to the centre of the prism and record the tape reading. Measure and record offset between sighting telescope and EDM telescope axes.

Point electronically to prism using maximum signal strength method. Record reading on horizontal tape to mm. Turn instrument horizontally in steps of 5mm to the right, measuring the distance twice and recording staff reading, distance and signal strength every time. As soon as no further measurements are possible, return to centre and repeat procedure to the left. Note all events, especially when you take away the attenuator cap (or change to open diaphragm with the KERN DM 501) and when flashing displays (etc.) occur. Use denser spacing if required.

5.4 Repeat 5.3 procedure in vertical direction, using the levelling staff as a reference.

5.5 If time is left repeat 5.3 and 5.4 over 10m using the same step interval 1' or 5mm respectively.

5.6 Measure dimension of front face of prism.

6. REPORT

Group reports are requested. Submission two weeks after practical. Report on First Part.

6.1 Plot the variation in the reduced distance vs distance as discussed on page 88 of the monograph number 7. The mean of double measurements should be used in this context.

6.2 Determine the amplitude and phase of the cyclic error if the shape of the plot indicates that this can be done. Compute new additive constant if applicable.

6.3 Compute and discuss the standard deviation of a single S* in the table made according to p. 88, monograph no. 7. Compare with earlier results. (F-test)

6.4 If no cyclic error can be detected, explain shape of error curve.

Report on Second Part.

6.5 For the 20m distance, plot distance and signal strength versus horizontal angle or staff reading (relative to reading to centre). Use 1mm graph paper.

6.6 For the 20m distance, plot distance and signal strength versus zenith distance or staff reading (relative to reading to centre). Use 1mm graph paper.

6.7 Plot the relative size of the prism front face into graphs 6.5 and 6.6. Comment on the effect of pointing errors on distance measurement.

6.8 Repeat 6.5 to 6.7 for 10m distance, if applicable.

J. M. Rüeger.

February, 1980.