Some do's and don't's in terrestrial surveying of site excentricities

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Characteristics of Electronic Tachymeters

Manufacturer	Model	Display mGrd	σ dir. mGrd	σ distance	Price
Leica	TC110	0.5	3.0	5 mm + 3 ppm	
	TC7xx	0.2	0.6	2 mm + 2 ppm	
	TC1103	0.5	1.5	2 mm + 2 ppm	
	TCA 1800	0.1	0.3	1 mm + 2 ppm	EUR 25,000
	TCA 2003	0.01	0.15	1 mm + 1 ppm	EUR 27,000
Sokkia	SET3110 M	0.2	1.0	2 mm + 2 ppm	EUR 17,000
Topcon	GPT 1001	0.2	0.6	3 mm + 2 ppm	EUR 16,000
Trimble	3303	0.2	1.0	3 mm + 3 ppm	
	5601 DR200+	0.1	0.3	3 mm + 3 ppm	EUR 21,000
Wild	TC1600	0.1	1.0	3 mm + 3 ppm	
Zeiss	Elta S10	0.1	0.3	1 mm + 2 ppm	EUR 20,000
	Elta S20	0.1	1.0	2 mm + 2 ppm	EUR 15,500

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Instrumental errors

scaled by distance

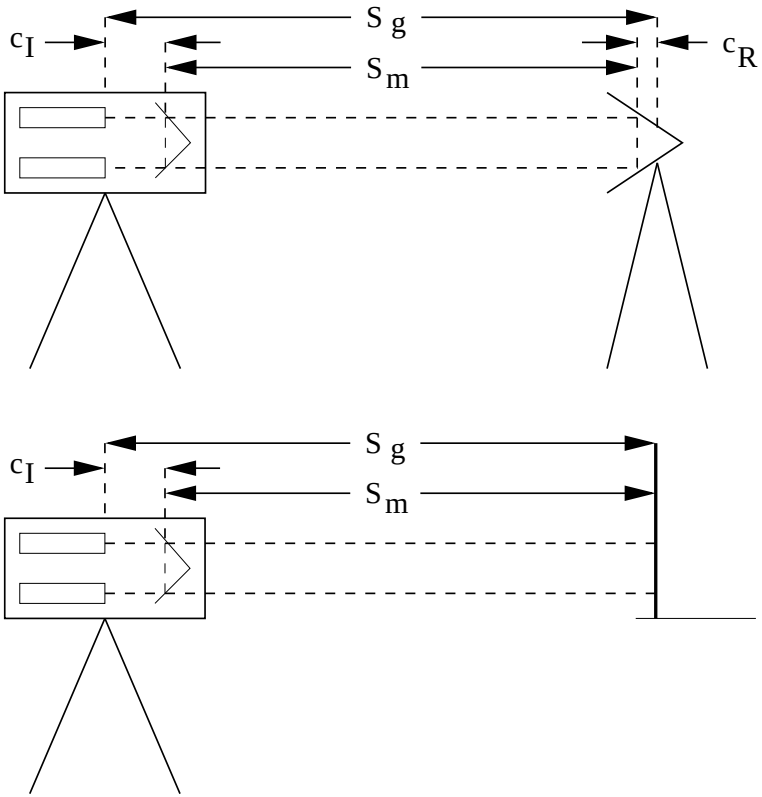
modulation frequency		$10^{-6} - 10^{-7}$
refraction/ meteorology		1 K $\equiv 1 \times 10^{-6}$
		4 HPa $\equiv 1 \times 10^{-6}$

independent of distance

integer cycles		free of error
phase	cyclic / inhomogenous	negligible
additive correction		0 - 35 mm

Cold start and temperature drift effects of additive correction

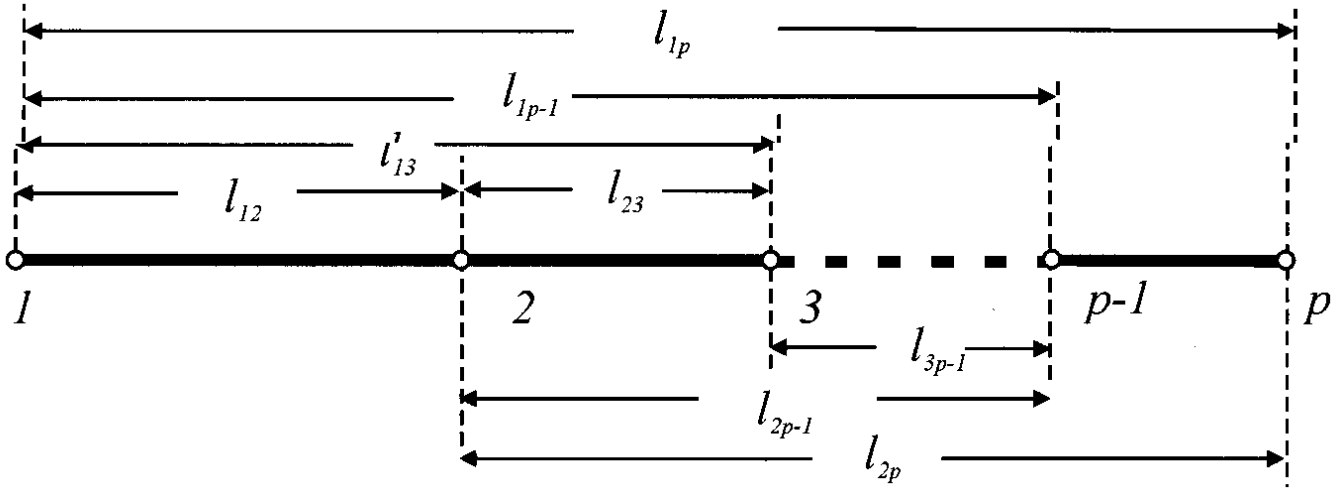
Additive corrections of instrument – prism combinations



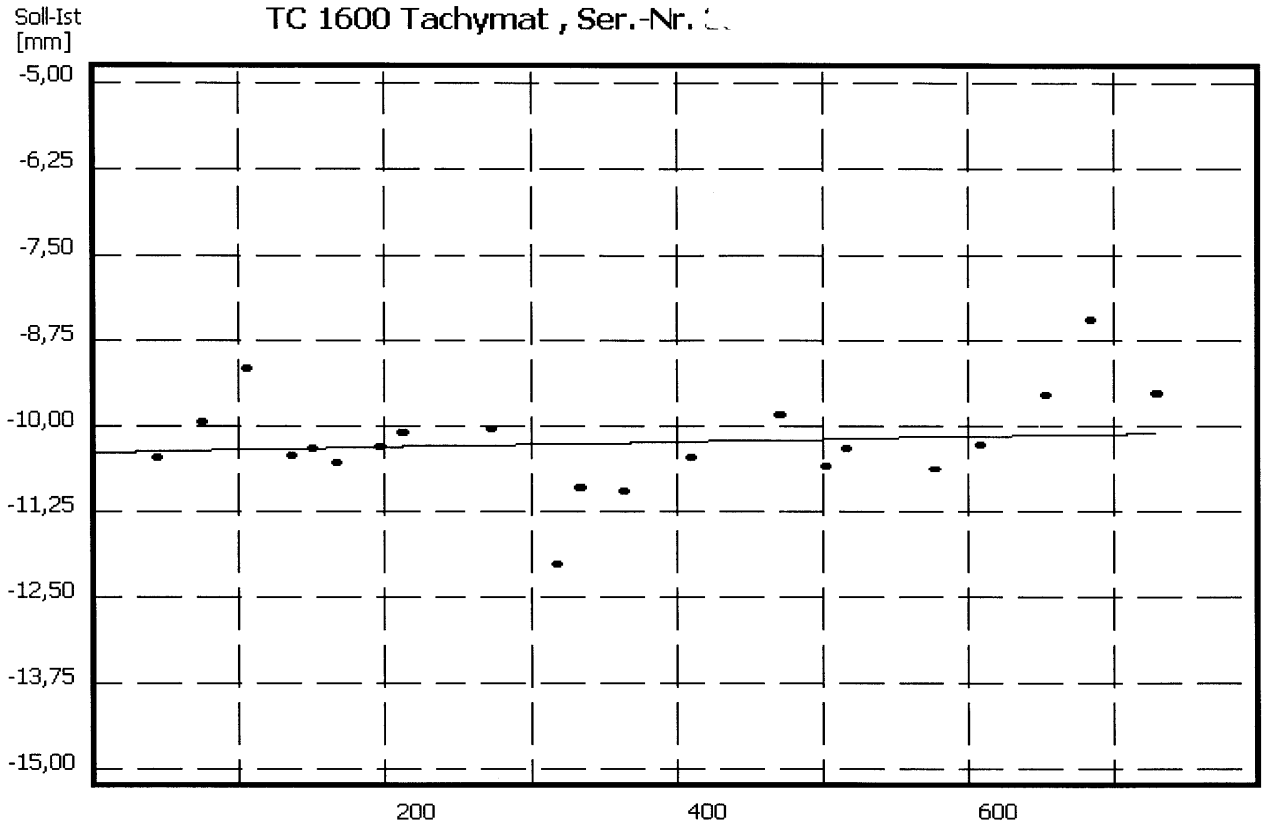
Additive corrections of instrument – prism combinations

Prism / Instrument	AGA	Nikon	Pentax	Sokkia	Topcon	Leica	Zeiss
AGA	0	0	0	-30	0	-35	-35
Nikon	0	0	0	-30	0	-35	-35
Pentax	0	0	0	-30	0	-35	-35
Sokkia	+30	+30	+30	0	+30	-5	-5
Topcon	0	0	0	-30	0	-35	-35
Leica	+35	+35	+35	+5	+35	0	0
Zeiss	+35	+35	+35	+5	+35	0	0

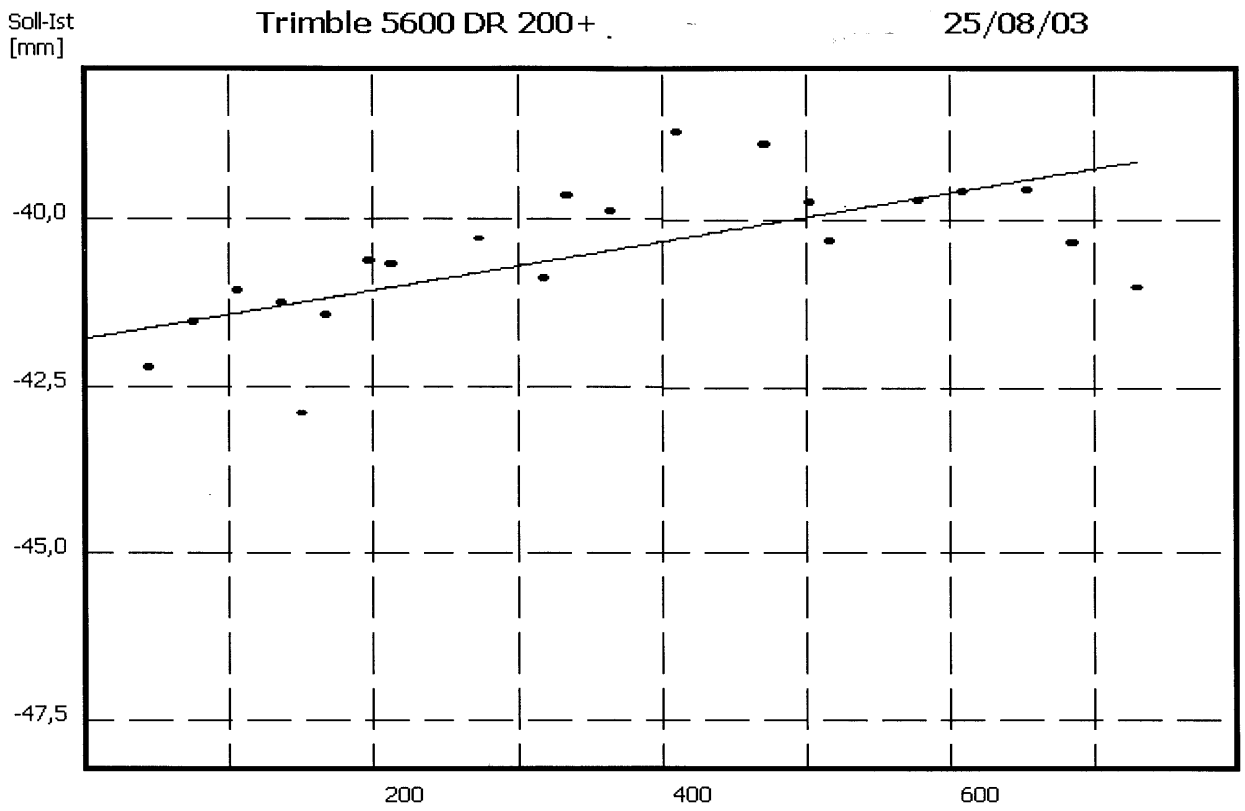
Setup of EDM calibration procedure



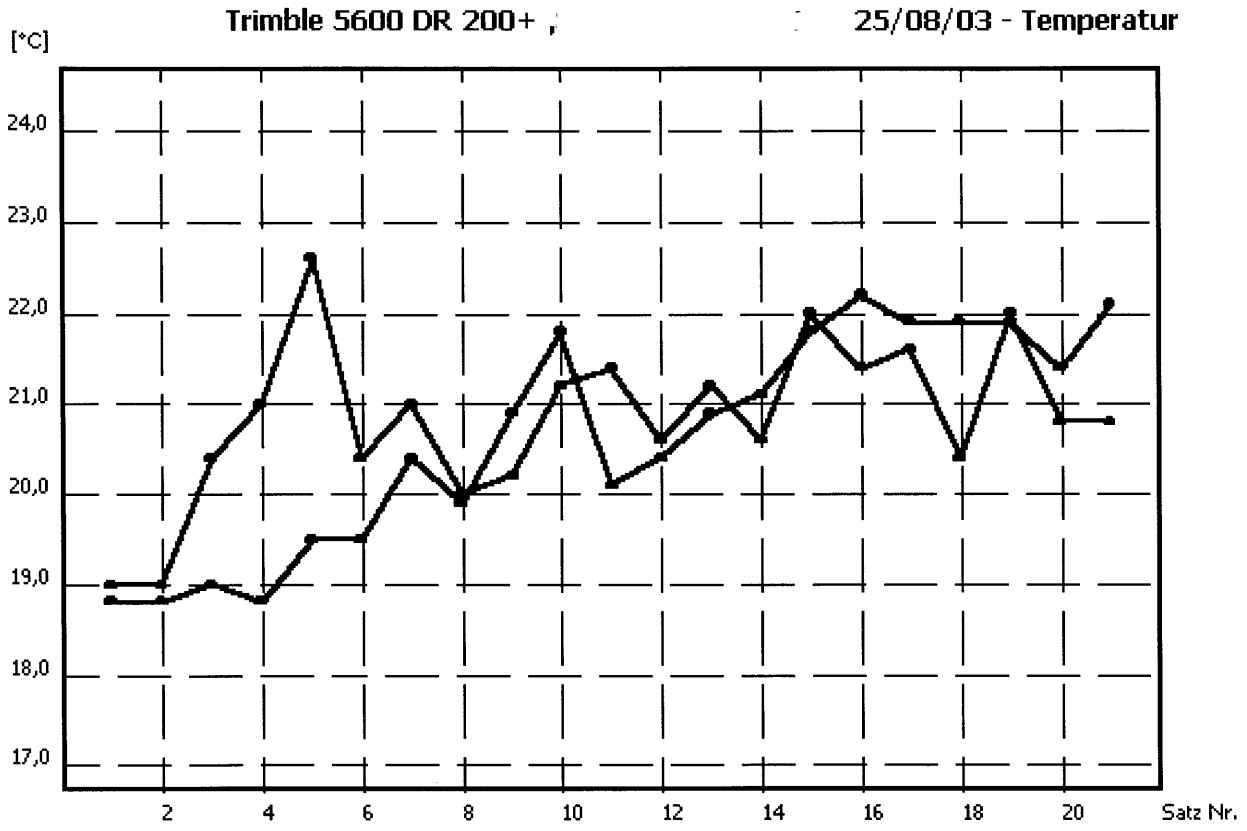
Results of EDM calibration procedure I



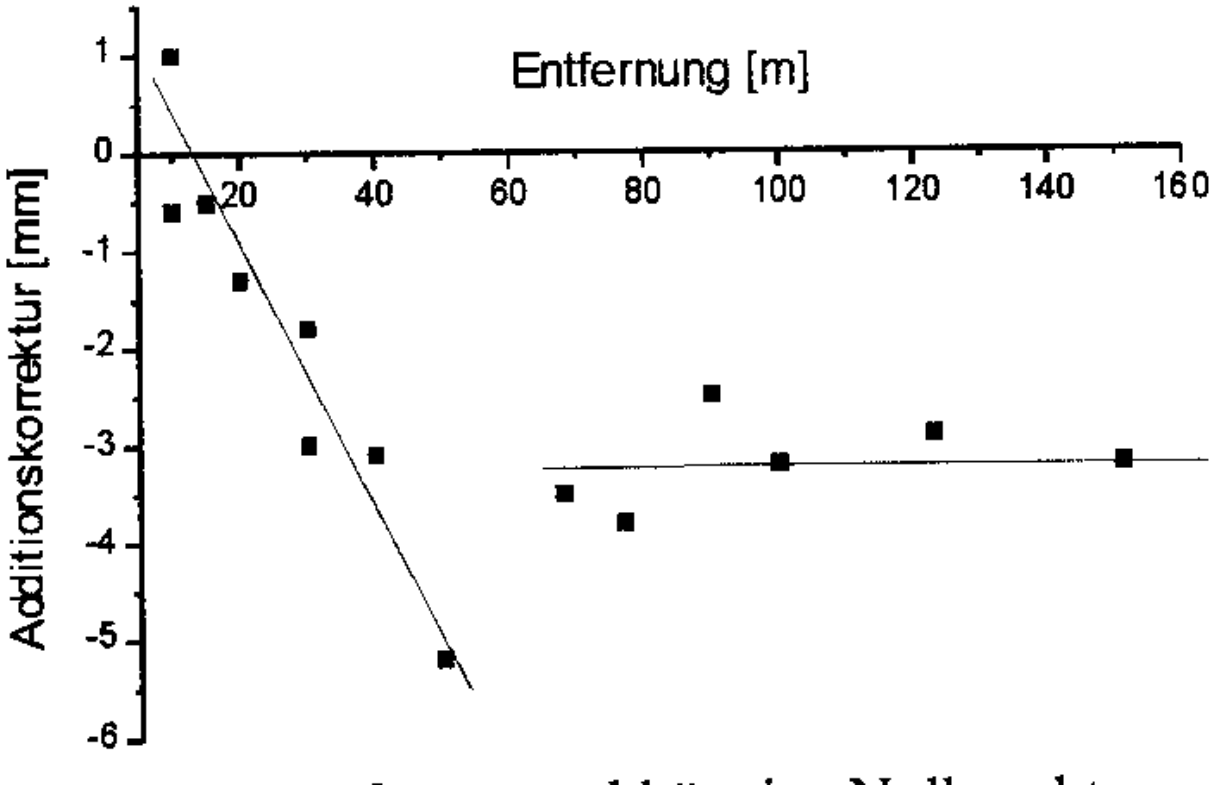
Results of EDM calibration procedure II



Temperature variations during EDM calibration procedure



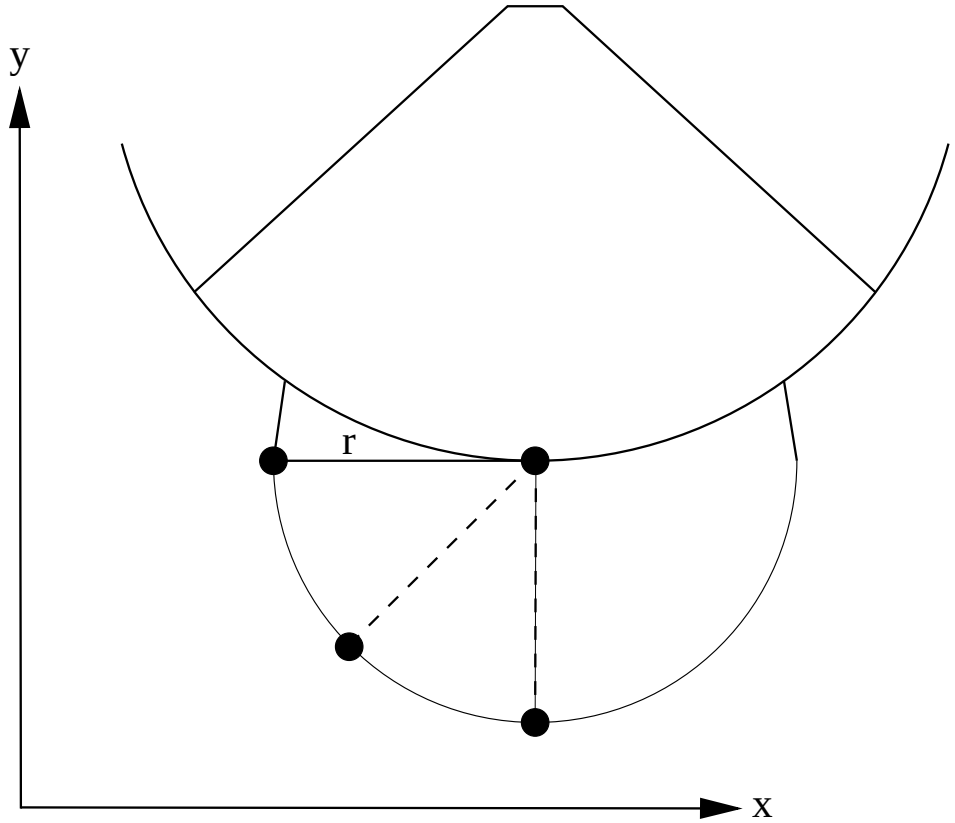
Distance dependence of additive constant



Precautions

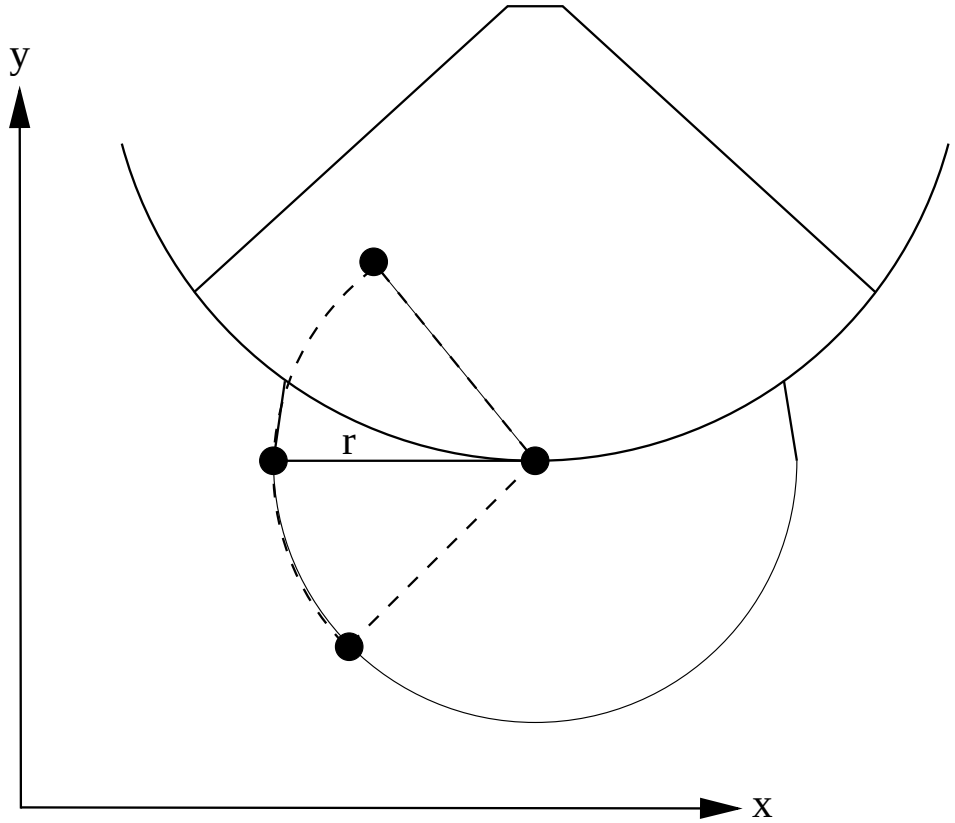
- Weather
  - Select stable weather (avoid temperature variations)
  - Optimal: Hazy (moist) weather with little wind
  - Avoid: Rapid change of sunshine and cloud occultation
- Cover
  - Use umbrella over instrument and reflector
- Handling of instrument
  - Permit acclimatisation of instrument
  - Permit warm-up period
  - Measure temperature at instrument and reflector
  - Measure pressure at instrument (and at reflector if large height difference)
  - Enter meteorological parameters only once (apply corrections in data reduction process)
  - Set additive correction to zero (apply corrections in data reduction process)

Correlations between parameters of adjustment of circle I



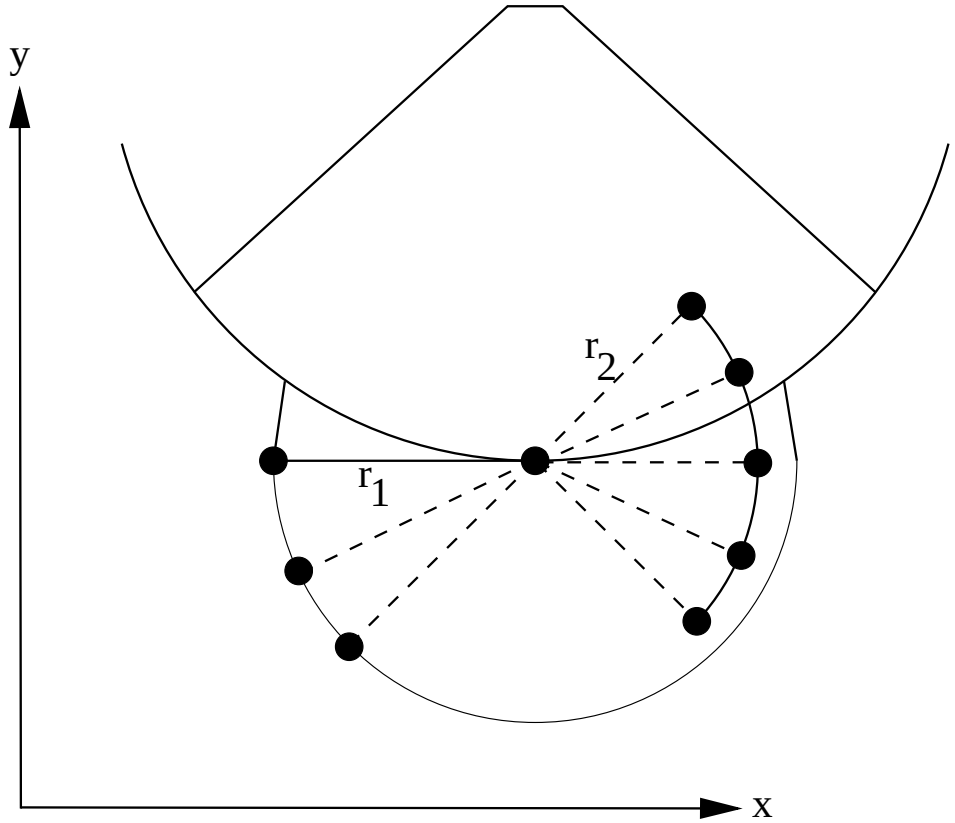
X_M	Y_M	R
1	0.89	0.96
0.89	1	0.96
0.96	0.96	1

Correlations between parameters of adjustment of circle II



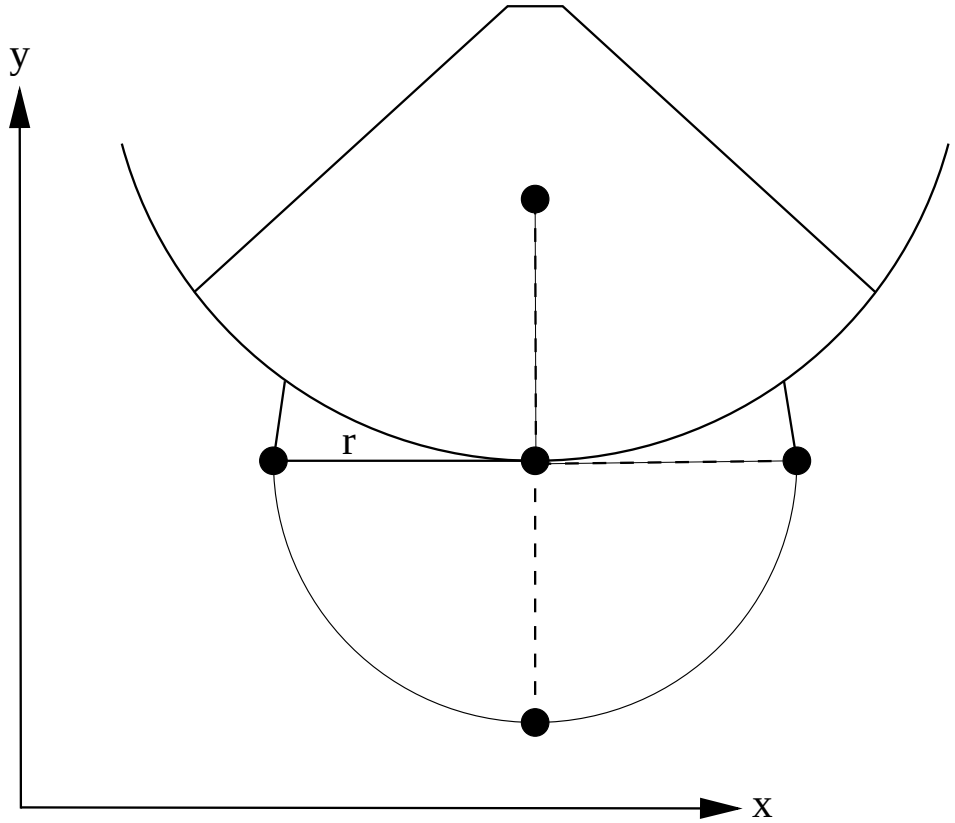
X_M	Y_M	R
1	0	0.99
0	1	0
0.99	0	1

Correlations between parameters of adjustment of circle III



X_M	Y_M	R_1	R_2
1	0.24	-0.99	0.97
0.24	1	-0.23	0.33
-0.93	-0.23	1	-0.96
0.97	0.33	-0.96	1

Correlations between parameters of adjustment of circle IV



X_M	Y_M	R
1	0	0
0	1	0
0	0	1