UNIVERSITI TEKNOLOGI MARA
College of Built Environment

Poster Book

IIIDBEEX 2023

20 JANUARY 2023

International Invention, Innovation & Design Exposition for Built Environment and Engineering 2023

College of Built Environment
UiTM Puncak Alam
20 January 2023 I Friday

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Analyses of least square methods for outlier(s) detection in cadastral network adjustment

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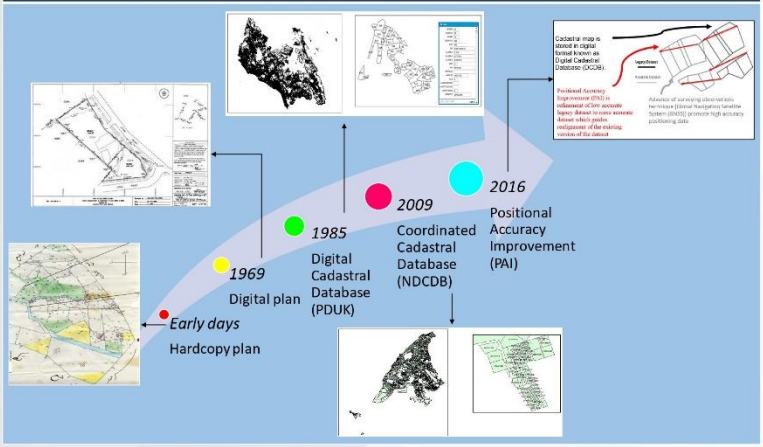
1. INTRODUCTION



2. PROBLEM STATEMENTS

1. The existence of outlier can significantly decrease the accuracy of land records **(Hashim et al., 2017)**.
2. Outliers can diminish the amount of information in survey datasets and making data analysis harder **(Wada, 2020).**
3. Resurvey and reprocessing the field book are complicated, expensive and time consuming **(Wada, 2020)**.
4. Former study has found that StarNet's test is less sensitive towards small outlier **(Abbas et al., 2021)**.

3. OBJECTIVES

1. To examine the reliability of least square outlier(s) detection approaches
2. To evaluate the sensitivity of least square outlier(s) detection approaches in detecting gross error(s) in cadastral network adjustment.

4. METHODOLOGY

1. Data acquisition

Table 1. Simulated traverse data

Sub-experiments	Augmented gross errors
i. Single distance measurement	5cm, 1m, and 5m
i. Single bearing measurement	1', 5' and 10'
i. Distances and bearings in multi-traverse line	5cm + 1', 1m+5' and 5m+10'

Table 2. Certified plans

Sub-experiments	No. of CPs	Production date	Location	Discrepancies (Distance, Bearing)	
				Line 1-2	Line 2-3
i. Two first-class measurement CPs	CP93164	March 23rd, 2009	Mukim Seriab, Perlis	29.556m 85° 39' 00"	37.298m 87° 07' 50"
	CP92873	April 7th, 2008		29.568m 85° 41' 10"	37.287m 87° 05' 50"
Positional error of bearing (m)				0.019	0.022
ii. First-class measurement and second-class measurement CPs	CP93387 (1st)	July 21st, 2009	Mukim Seriab, Perlis	21.148m 124° 36' 10"	75.273m 133° 16' 40"
	CP33758 (2nd)	Sept 28th, 1969		21.163m 124° 34' 00"	75.297m 133° 18' 00"
Positional error of bearing (m)				0.013	0.029
iii. Two second-class measurement CPs	CP90416	Nov 6th, 2003	Mukim Titi Tinggi, Perlis	6.220m 295° 47' 00"	115.670m 45° 06' 30"
	CP61325	Jun 28th, 1989		6.220m 295° 49' 00"	115.620m 45° 05' 00"
Positional error of bearing (m)				0.004	0.05

4. METHODOLOGY (cont..)

2. Data processing

1. Computation of least square adjustment (LSA)

2. Global test

Two-tailed test based on Chi-square distribution:

$$\frac{rS^2}{X^2_{\alpha/2}} < \sigma_0^2 < \frac{rS^2}{X^2_{1-\alpha/2}}$$

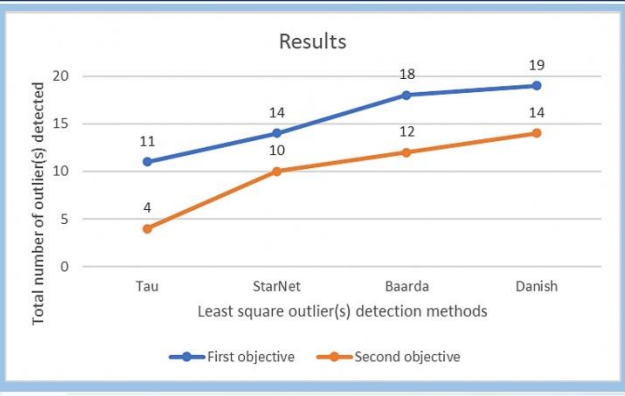
Presence of outlier(s):

$$H_0: \hat{\sigma}^2 = \sigma_0^2$$
$$H_a: \hat{\sigma}^2 > \sigma_0^2$$

3. Local test

Methods of local test	Standardised residuals	Critical value, c
Baarda	$\bar{v}_i = \frac{v_i}{(diagonal)\left(\sqrt{\sum v}\right)}$	3.29
StarNet	$\bar{v}_i = \frac{v_i}{\sigma_0}$	3.00
Tau	$\bar{v}_i = \frac{v_i}{(diagonal)\left(\sqrt{\sum Varv}\right)}$	Tau (τ) distribution
Danish	$\bar{v}_i = \frac{v_i}{(diagonal)\left(\sqrt{\sum L^a}\right)\sqrt{r_i}}$	3.00

5. FINDINGS



6. NOVELTY

1. **StarNet method** reveals the limitations of detecting outliers when data sets from multiple survey classes are used.

7. CONCLUSION

1. The findings reveal that the excellent performance of outlier detection when tested on both combination of similar and different survey's classes is demonstrated using **Danish's method.**

8. COMMERCIALIZATION

1. Develops a commercial software based on Danish method for outlier detection to enhance positioning accuracy in cadastral network adjustment.

9. RECOGNITIONS

Deepest appreciation to:
1. Assoc. Prof. Dr. Sr. Mohd Azwan Abbas

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