行政院國家科學委員會專題研究計畫　成果報告

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※ THE STUDY OF DYNAMIC PROCESS CONTROL ※

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動態管制圖之研究

THE STUDY OF DYNAMIC PROCESS CONTROL

計畫編號: NSC 09-2118-M-004-006
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1. ABSTRACT

The study considers the adaptive statistical process control for two dependent process steps. There are three topics in the study. First, we propose the two adaptive sampling interval control charts to monitor and distinguish two dependent process steps effectively. The performance is measured by average time to signal (ATS) which is derived by Markov chain approach. The performance of the ASI control charts is compared with FSI control charts. It is demonstrated that the ASI control charts outperforms the FSI control charts. Some sensitivity analysis illustrates the effects of process parameters on the ATS. Second, the adaptive sample size control charts are derived to monitor and distinguish the two dependent process steps effectively. Its performance is also measured by average time to signal (ATS) which is derived by Markov chain approach. The performance of the ASS control charts is compared to the FSS control charts. It is demonstrated that the performance of the ASS control charts is much better than the FSS control charts. Sensitivity analysis illustrates the effects of process parameters on the ATS. Third, we combine the adaptive sample size and adaptive sampling interval to derive the ASSI control charts to monitor and distinguish two dependent process steps effectively. Its performance is also measured by average time to signal (ATS) which is derived by Markov chain approach. The performance of the ASSI control charts is compared with FSSI control charts. It is demonstrated that the ASSI control charts is much better than the FSSI control charts for very small shifts in process mean, but the performance of FSSI control charts is better than ASSI control charts for moderate shifts in the process means.

Keywords: dependent process steps, control charts, adaptive sampling interval and sample size.

中文摘要

本研究提出製程上特殊因的發生服從多個韋伯分配的監控方法。它能有效區分是製程平均數或變異數是失控的，以使失控的製程迅速回復穩定中。X-bar 管制圖和 S 控管制圖分別被發展以能經濟有效的管制製程並顧及顧客對品質的聲音。資料模擬結果說明這些管制圖的建立，應用及參數之敏感度。另外，製程上多元製程變數的追蹤也考慮製程上特殊因的發生服從多個韋伯分配的情形，多元管制

圖被發展以能經濟有效的管制製程並顧及顧客對品質的聲音。資料分析結果說明這些管制圖的建立,應用及參數之敏感度。

關鍵字:管制圖，更新報酬過程，韋伯分配，多元製程變數。

2. RESEARCH MOTIVATION AND OBJECTIVE

So far, all papers about the adaptive control charts consider only for a single process. Recently, most of the products are produced from multiple process steps. Hence, the Shewhart control charts are not appropriated to monitor the each one of the dependent process steps. The derivation of cause-selecting control charts is proposed by Zhang and used effectively to monitor the specific quality on the second process step, which adjust the effect of in-coming quality from the out-going quality. There are some papers about dependent process steps control from economic viewpoints. However, the derivation of adaptive control charts and used to monitor the dependent process steps control has not been addressed.

3. RESULTS AND DISCUSSION

Results:

Three topics are finished, and the three papers are going to submit to international journal. The three topics are as follows.

(1) The adaptive sampling interval control charts for two dependent process steps is derived. The performance of the control charts is measured by average time to signal (ATS), which is derived by Markov chain approach. The performance of ASI and FSI charts are compared. It shows that the performance of ASI charts is much better. Sensitivity analysis illustrates the effects of process parameters on the ATS.

(2) The adaptive sample size control charts for two dependent process steps is derived. The performance of the control charts is measured by average time to signal, which is derived by Markov chain approach. The performance of ASS and FSS charts are compared. It shows that the performance of ASS charts is much better. Sensitivity analysis illustrates the effects of process parameters on the ATS.

(3) The combined adaptive sample size and sampling interval control charts for two dependent process steps is derived. The performance of the control charts is measured by average time to signal, which is derived by Markov chain approach. The performance of ASSI and FSSI charts are compared. It shows that the performance of ASS charts is much better for very small shifts in process mean, but the performance of FSS charts is better for moderate shifts in process mean. Sensitivity analysis illustrates the effects of process parameters on the ATS.

Suggestion:

All the three topics consider the

statistical adaptive control for dependent process steps. The approaches may be extended to derive the adaptive control charts from economic viewpoints or for other control charts, like attribute control charts etc.

4. EVALUATION

Three topics are finished and going to submit to international journals. We expect that they will be published on the journals.

REFERENCES

[1] Amin, R. W. and Miller, R. W. (1993), "A Robustness Study of $\overline{X}$ Charts with Variable Sampling Intervals," *Journal of Quality Technology* **25**, pp. 36-44.

[2] Costa, A. F. B. (1994), "$\overline{X}$ Charts with Variable Sample Size," *Journal of Quality Technology* **26**, No. 3, pp.155-163.

[3] Costa, A. F. B. (1997), "$\overline{X}$ Chart with Variable Sample Size and Sampling Intervals," *Journal of Quality Technology* **29**, No. 2, pp. 197-204.

[4] Costa, A. F. B. (1998), "Joint $\overline{X}$ and R Charts with Variable Parameters," *IIE Transactions* **30**, pp. 505-514.

[5] Costa, A. F. B. (1999), "$\overline{X}$ Charts with Variable Parameters," *Journal of Quality Technology* **31**, No. 4, pp. 408-416.

[6] Cui, R. and Reynolds, M. R., Jr. (1988), "$\overline{X}$ -Charts with Runs Rules and Variable Sampling Intervals," *Communications in Statistics-Simulation and Computation* **17**, pp. 1073-1093.

[7] Daudin, J. J. (1992), "Double Sampling $\overline{X}$ Charts," *Journal of Quality Technology* **24**, pp.78-87.

[8] Epprecht, E. K., Costa, A. F. B. and Mendes, F. C. T. (2003), "Adaptive Control Charts for Attributes," *IIE Transactions* **35**, pp.567-582.

[9] Grant, E.L. and Leavenworth, R.S. (1988), *Statistical Quality Control*, Sixth Edition, McGraw-Hill Co., New York.

[10] Lucas, J. M. (1982), "Combined Shewhart -CUSUM Quality Control Schemes," *Journal of Quality Technology* **14**, pp. 51 –59

[11] Lucas, J. M. and Saccucci, M. S.

(1990), “Exponentially weighted moving average control schemes: Properties and enhancements,” *Technometrics* **32**, pp. 1-29

[12] Prabhu, S. S., Montgomery D. C. and Runger G. G. (1994), “A Combined Adaptive Sample Size and Sampling Interval $\overline{X}$ Control Scheme,” *Journal of Quality Technology* **26**, No. 3, pp. 164-176.

[13] Prabhu, S. S., Runger, G. C. and Keats, J. B. (1993), “$\overline{X}$ Chart with Adaptive Sample Sizes,” *International Journal of Production Research* **31**, pp. 2895-2909.

[14] Reynolds, M. R., Jr. (1996), “Shewhart and EWMA Variable Sampling Interval Control Charts with Sampling at Fixed Times,” *Journal of Quality Technology* **28**, No. 2, pp. 199-212.

[15] Reynolds, M. R., Jr., Amin, R. W. and Arnold, J. C. (1990), “CUSUM Charts with Variable Sampling intervals,” *Technometrics* **32**, pp. 371-384.

[16] Reynolds, M. R., Jr., Amin, R. W., Arnold, J. C. and Nachlas, J. A (1988), “$\overline{X}$ Charts with Variable Sampling Intervals,” *Technometrics* **30**, No. 2, pp. 181-192.

[17] Reynolds, M. R., Jr. and Arnold, J. C. (2001), “EWMA Control Charts with Variable Sample Sizes and Variable Sampling Intervals,” *IIE Transactions* **33**, pp.511-530.

[18] Runger, G. C. and Pignatiello, J. J., Jr. (1991), “Adaptive Sampling for Process Control,” *Journal of Quality Technology* **23**, No. 2, pp. 135-155.

[19] Saccucci, M. S., Amin, R. W. and Lucas, J. M. (1992), “Exponentially Weighted Moving Average Control Schemes with Variable Sampling Intervals,” *Communications in Statistics-Simulation and Computation* **21**, pp. 627-357.

[19] Shewhart, W. A. (1931), *Economic Control of Quality of Manufactured Product*, D. Van Nostrand Co., New York.

[20] Wade, M. R. and Woodall, W. H.

(1993), “A Review and Analysis of Cause-Selecting Control Charts,” *Journal of Quality Technology* **25**, No. 3, pp. 161-169.

[21] Zhang, G. X. (1984), “A New Type of Control Charts and a Theory of Diagnosis with Control Chats,” *World Quality Congress Transactions*. American Society for Quality Control, pp. 175-185.

[22] Zimmer, L. S., Montgomery, D. C. and Runger, G. C. (1998), “Evaluation of the Three-State Adaptive Sample Size $\overline{X}$ Control Chart,” *International Journal of Production Research* **36**, 733-743.