Process Monitoring

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Chapter 3b
Multivariate Statistical Process Monitoring

Chapter Description

- Aims
  - Analyze the process performance based on MSPM approach.
- Expected Outcomes
  - Develop a fault detection mechanism as well as perform investigation based on a specified case study by using a specialized software.
- Other related Information

Subtopics

3.13 Phase II: Fault Detection

3.14 Phase II: Fault Identification

3.13 Phase II: Fault Detection

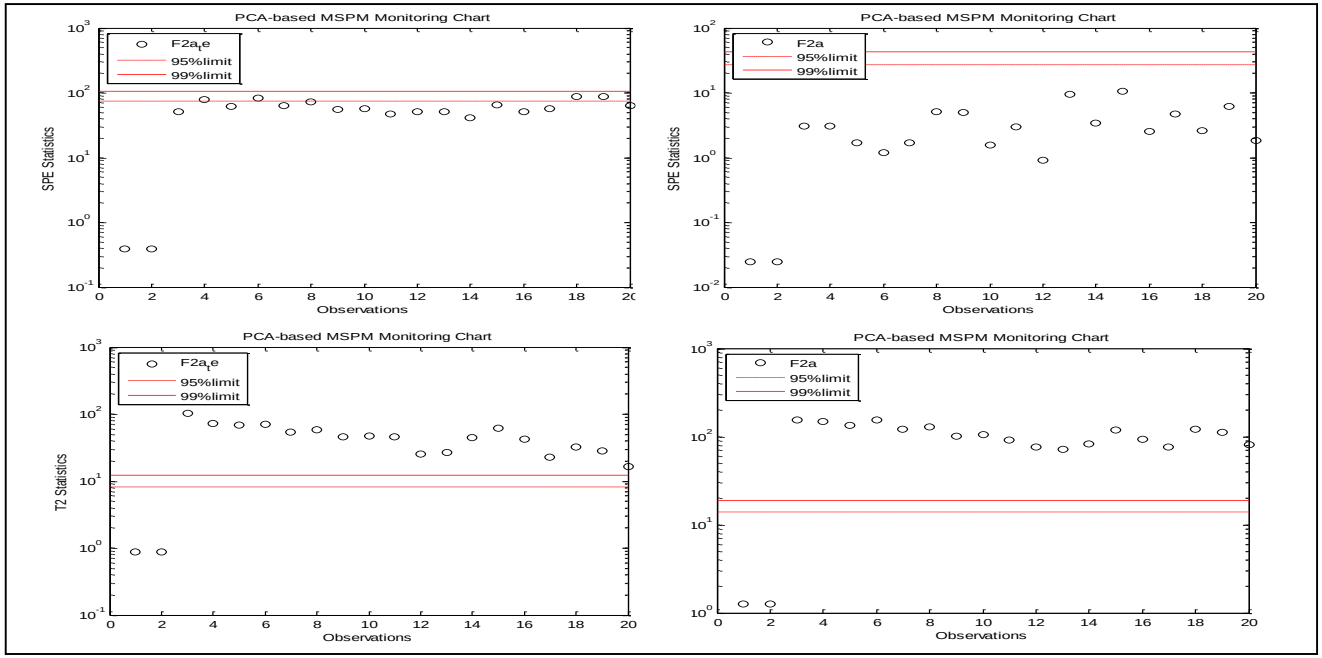
- Steps 5 to 7 follow similar procedures of steps 1 to 3 in phase I (all the main parameters – eigenvectors, eigenvalues, no. of data compression of Phase I, are utilised again in Phase II).
- Regarding step 8 (the last step), there are two main operations which have to be conducted separately - fault detection and fault identification.

3.13 Phase II: Fault Detection

Fault detection:

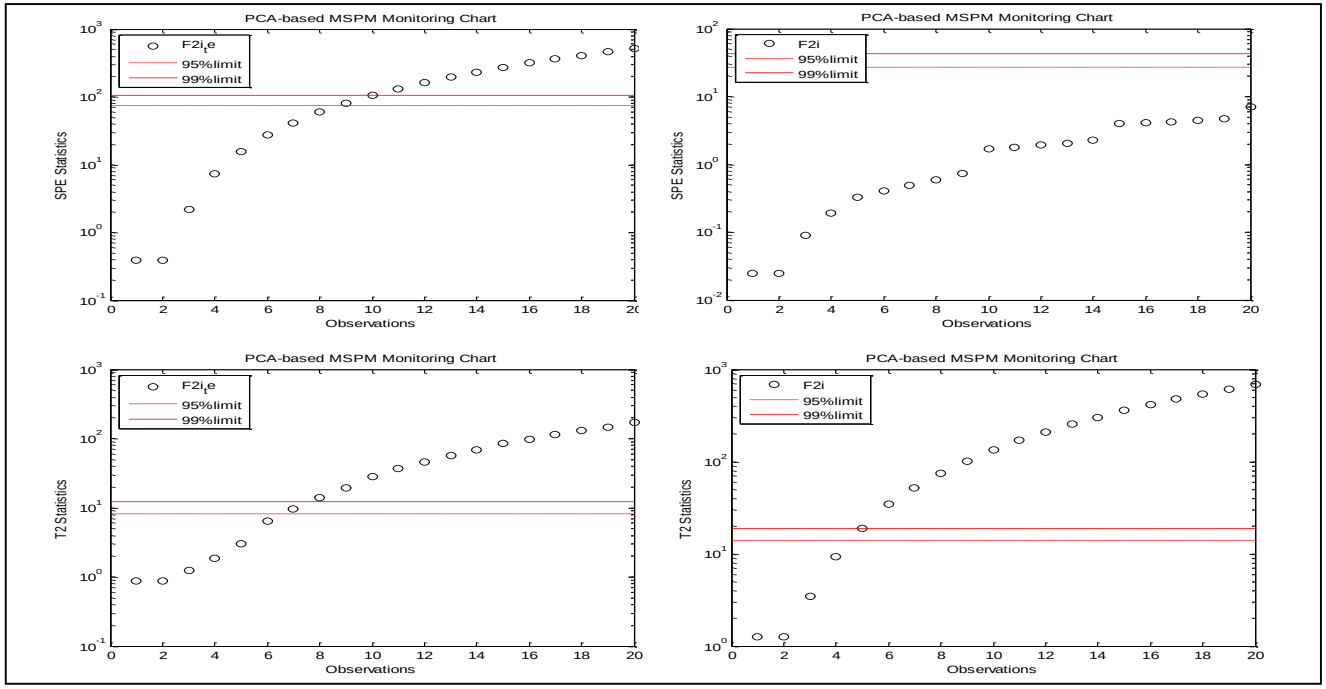
- A fault situation is regarded as a result of an occurrence of a special event that is not in conformance to the common cause nature .
- Technically, a fault situation will be declared if either of the monitoring statistics exceeding its respective control limit for a pre-defined successive number of samples consistently.

3.13 Phase II: Fault Detection



Monitoring progression of SPE on F2a based on PCA models with 3 PCs (top left) and 6 PCs (top right). Monitoring progression of T^2 on F2a based on PCA models with 3 PCs (bottom left) and 6 PCs (bottom right).

3.13 Phase II: Fault Detection



Monitoring progression of SPE on F2i based on PCA models with 3 PCs (top left) and 6 PCs (top right). Monitoring progression of T^2on F2i based on PCA models with 3 PCs (bottom left) and 6 PCs (bottom right).

3.13 Phase II: Fault Detection

Fault Detection Sampling Time		
Fault Cases	PCs 5	
	T2	SPE
1a	3	6
2a	3	x
3a	3	3
4a	3	3
5a	3	3
6a	3	3
7a	x	4
8a	3	3
9a	3	3
10a	3	3
11a	3	3

Fault Detection Sampling Time (Summary)	
1a	3
2a	3
3a	3
4a	3
5a	3
6a	3
7a	4
8a	3
9a	3
10a	3
11a	3

Fault Detection Delayed Time	
1a	1
2a	1
3a	1
4a	1
5a	1
6a	1
7a	2
8a	1
9a	1
10a	1
11a	1

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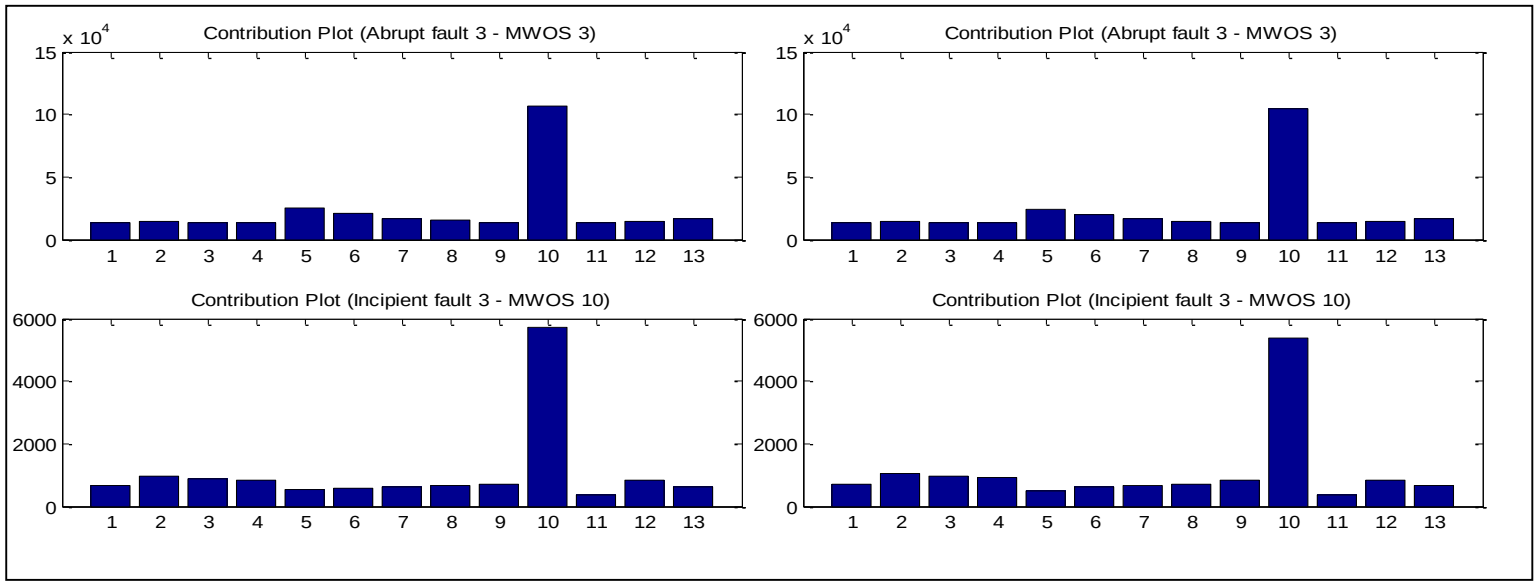
3.14 Phase II: Fault Identification

Fault Identification - the contribution plot technique is proposed to identify the potential variables that possibly connected to the detected problem.



Contribution plots of PCA with 3 dimensions for F3a (top left) and F3i (bottom left); contribution plots of PCA with 6 dimensions for F3a (top right) and F3i (bottom right)

References

- Green, P.E., and Carroll, J.D., (1976). *Mathematical Tools for Applied Multivariate Analysis.* New York, USA: Academic Press.
- Jackson, J.E., (1991). *A User's Guide To Principal Components.* John Wiley and Sons. USA.
- Martin., E.B., Morris, A.J., and Zhang, J. (1996). Process Performance Monitoring Using Multivariate Statistical Process Control. *Systems Engineering for Automation,* IEEE Proceedings.

Authors Information

Credit to the authors: