

Discussion of  
“Nonparametric Profile Monitoring  
by Mixed Effects Modeling”  
by Qiu, Zou & Wang

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# What are important aspects of profile monitoring?

- Strategy of this discussion:
  - List desiderata for general profile monitoring methods, in 5 general categories.
  - Comment on the focus of Qiu, Zou & Wang in this context.

# 1. Flexibility of purpose

- Profiles can vary in many ways, which we might want to detect:
  - Special features (maximum, location of event ...)
  - Movement toward a given “bad” profile
  - \*\* Arbitrary change in profile mean
  - Changes in variation (white noise or functional)

## 2. Flexibility of application

- Can the method be used for a variety of profile applications?
  - \*\* Different shapes?
  - Subgrouping?
  - \*\* Time spacing
  - Registration
  - Automation
  - Presence of covariates?

# 3. Modelling Assumptions

- 3 key simplifications:
  - \*\*Is variance constant along a curve?
  - \*Within-curve correlation?
  - Between curve correlation?
- Nonconstant variance and within curve correlation modelled via random effects in Phase I, which are dropped in Phase II for computational efficiency.

## 4. Phase I Issues

- \*\* Phase I computations can be done offline
- Need for an in-control Phase I dataset
- \* Theory & analysis of Phase I data to provide Phase II control limits
  - Empirical approach requires large Phase I set.

# 5. Properties of Phase II Algorithm

- \*\* Needs to be quick as new profiles arrive
- \*Good detection properties for relevant departures (many possibilities under “1. flexibility of purpose”)
- \*Interpretability.
  - Curve visualization helps, but if that fails, pinpointing difficult.

# Closing thoughts

- This paper introduces us to profile monitoring, showing one complete approach.
  - Other approaches possible
  - Many desiderata listed above are present in their approach.