

Fleet Monitoring Concept and New Statistical Evaluation Methods Supplement for interested

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Time-Series Project Proposal for VERT-2016
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Supplement for interested

Organisational

How should it work?

Fleet manager's window exhibits

vehicles marked green or yellow or red

yellow (caution) - red (failure, immediate action)

Next window:

vehicle no; logger no; failure type; rec.proceed



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Organisational

Nöthiger's task:

Logger system check:

Voltage? Data-transfer? Signal/noise? Electronic-system? Computational function?

Sensor check:

Pressure? Temperature? Rpm? GPS? Lambda?
NOx-sensor?



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Organisational

Legerer - (Schmid programming):

Present checks of malfunctions

plus

extension into prediction

Present checks: 4 categories

F-substrate; regeneration; engine; lubrication



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L.C. Larsen:

"It's no so easy to design a DPF with good regeneration"

Present checks

- How do we conceive a DPF's operation? -
Without any desire to challenge present concepts,
however, we should avoid complacency

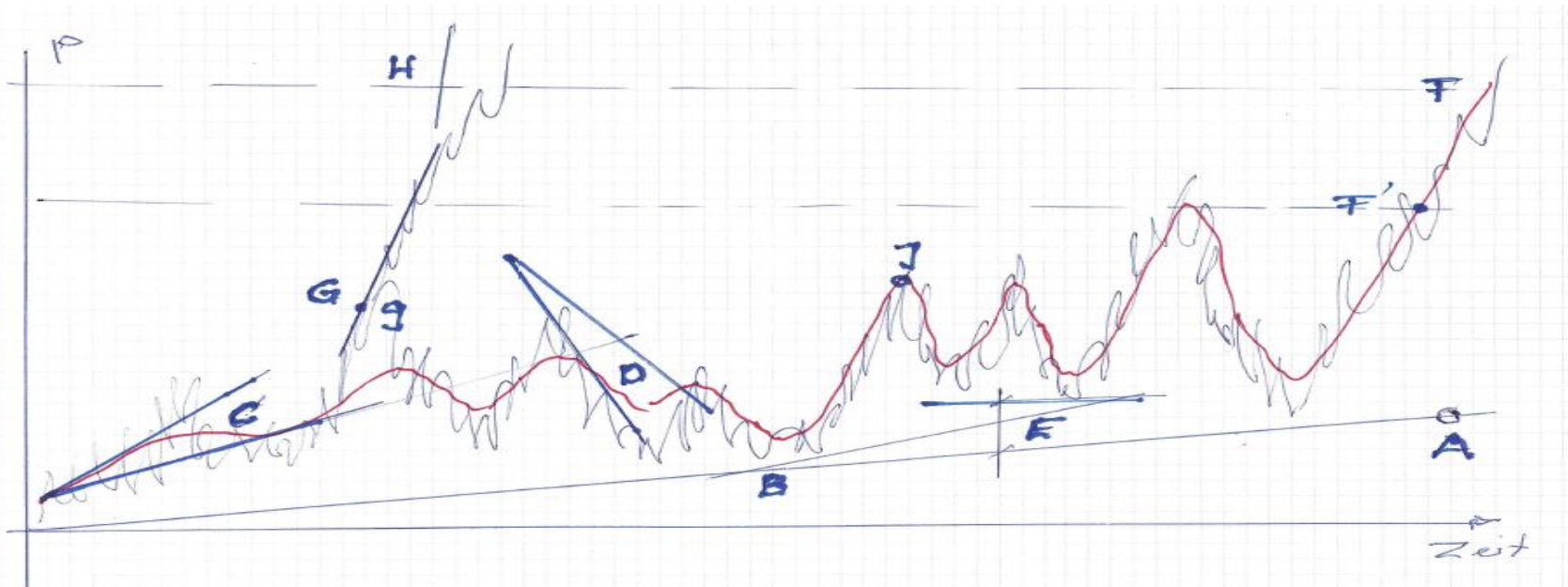


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Present checks, our imagination (scheme Dr A.Mayer)

x



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Mayer's watchlist and how to quantify:

Back-pressure too high => definition (alarms: yellow and red DPF cleansing F' , F)

Back-pressure too low (trend falling) => leak in substrate PN control early detection enables repair at low cost

Gradient of back pressure accelerated: Engine or regeneration (C)

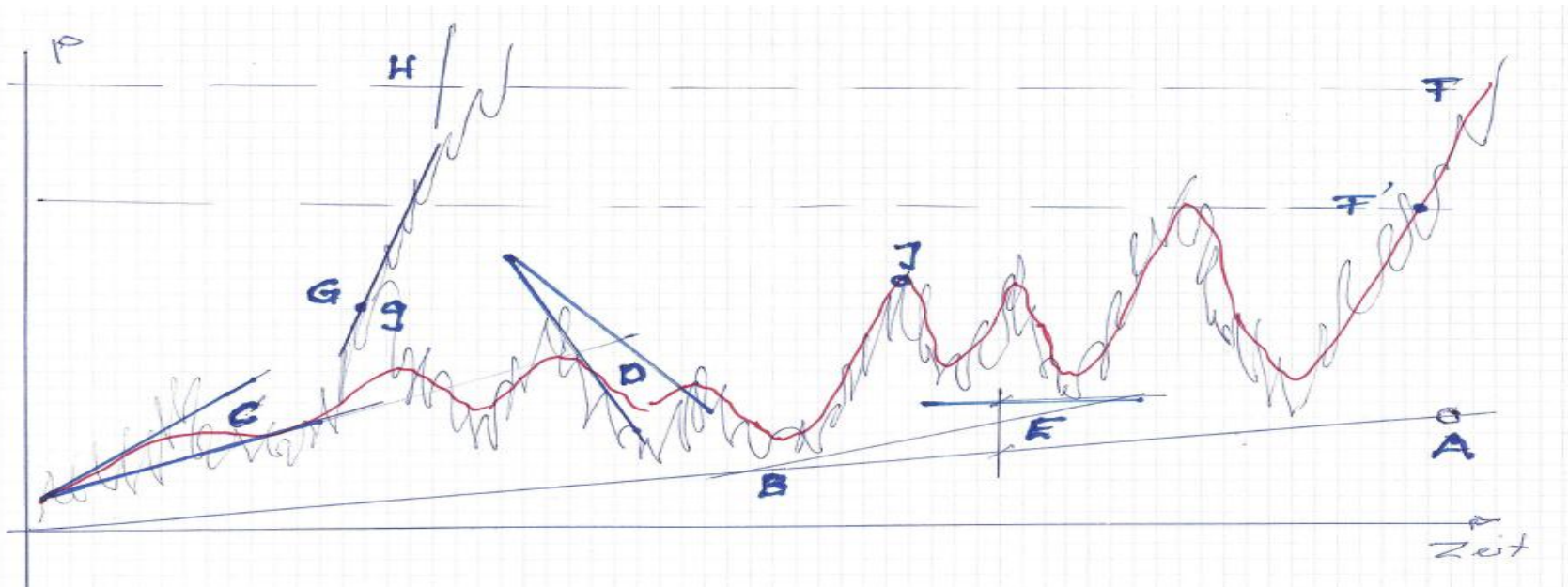
Soot load rapidly and progressively increasing - How to quantify (curvature?) => early alarm (G, H)

Prediction of ash cleansing [operating hours] A

Gradient of ash load increasing => engine oil, engine ?



Regenerating



Regeneratingsystem

Gradient of pressure decrease (slope) (D) „too flat“ =>
FBC lacking, check with temperature profile; check DOC interval
of peaks increasing (J)

Base pressure after regeneration is too high (E); end of
regeneration too soon (E)

Engine:

Increased soot production (C, G) combined with increased ash (B)

Exhaust-temperature increasing, peaks $t > 600$ °C

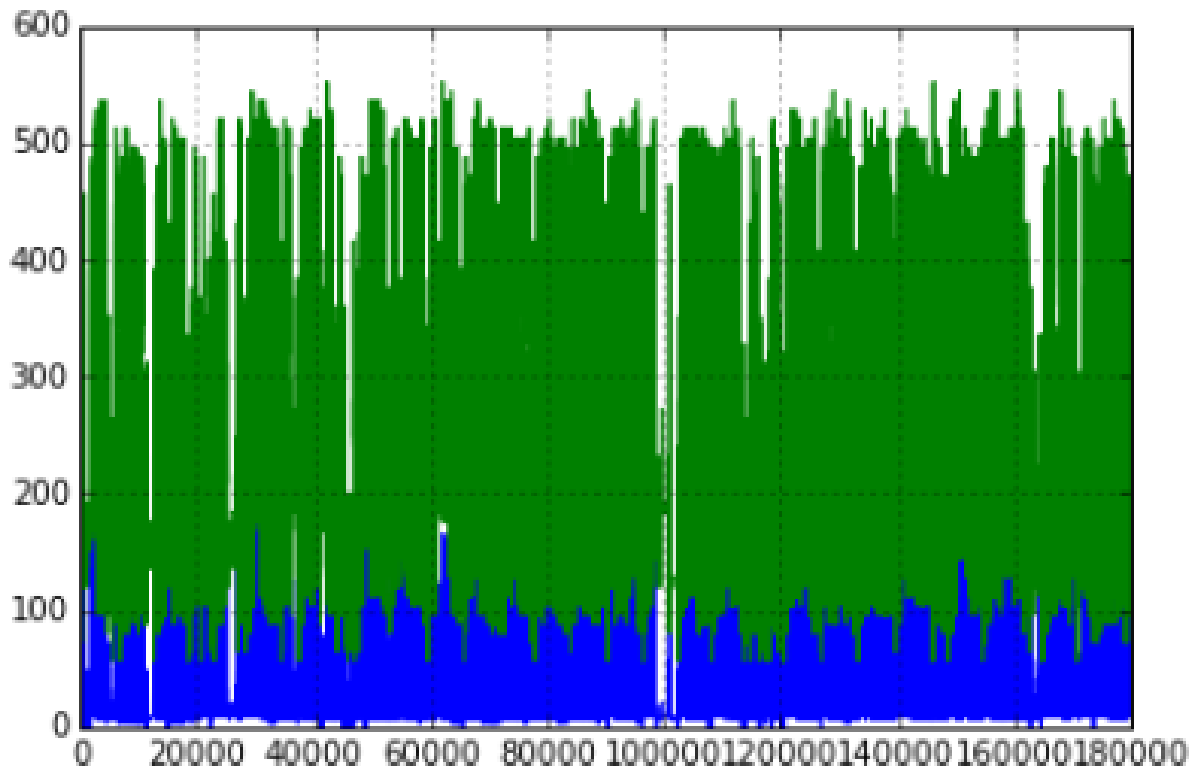
Lubrication: Trend in prediction of cleansing

Exploration of mystery effects



How to quantify heuristic considerations?

At present: one particular realisation of a stochastic process



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Notation

At present moments:

- mean (=average)
- standard deviation (= square root of variance or mean square = M_2)
- 3rdorder moment M_3 (obviously useful for type of data)

How to go about quantification of heuristic considerations:

Splitting, 1.attempt

180'000 hrs divided into 10 blocks à 18'000 hrs;

measurements, 10 sec each lumped to 5 min. (=30)

Reason: Fundamentals of Probability Theory

- bounds for real values of measured quantity



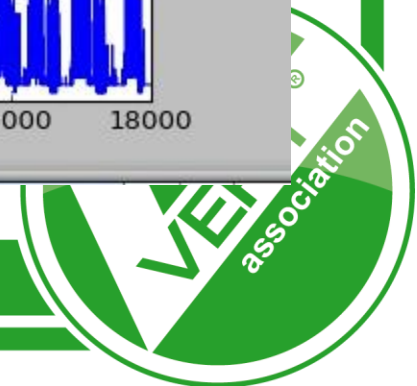
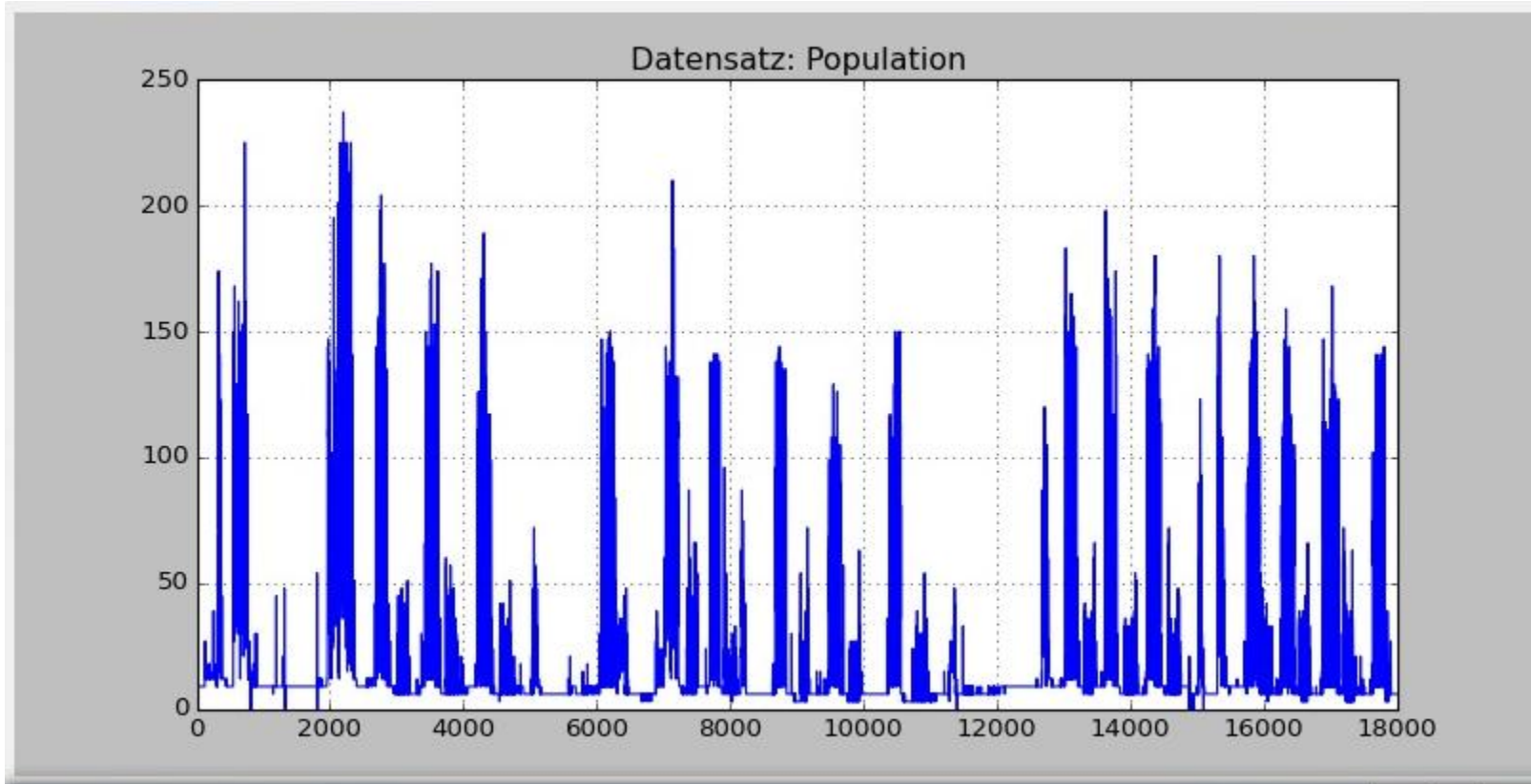
Further notations

- Covariance function
- Auto -CF (= extension to a mean square of a lag)
- Cross -CF (= mean square of a cross product)
- **Correlation functions:** same for standardised data,
- (auto-correlation, cross correlation
- our choice: Poisson -distributed
- Correlation functions of higher order =
Wehrmann' s extension (= scientific part)



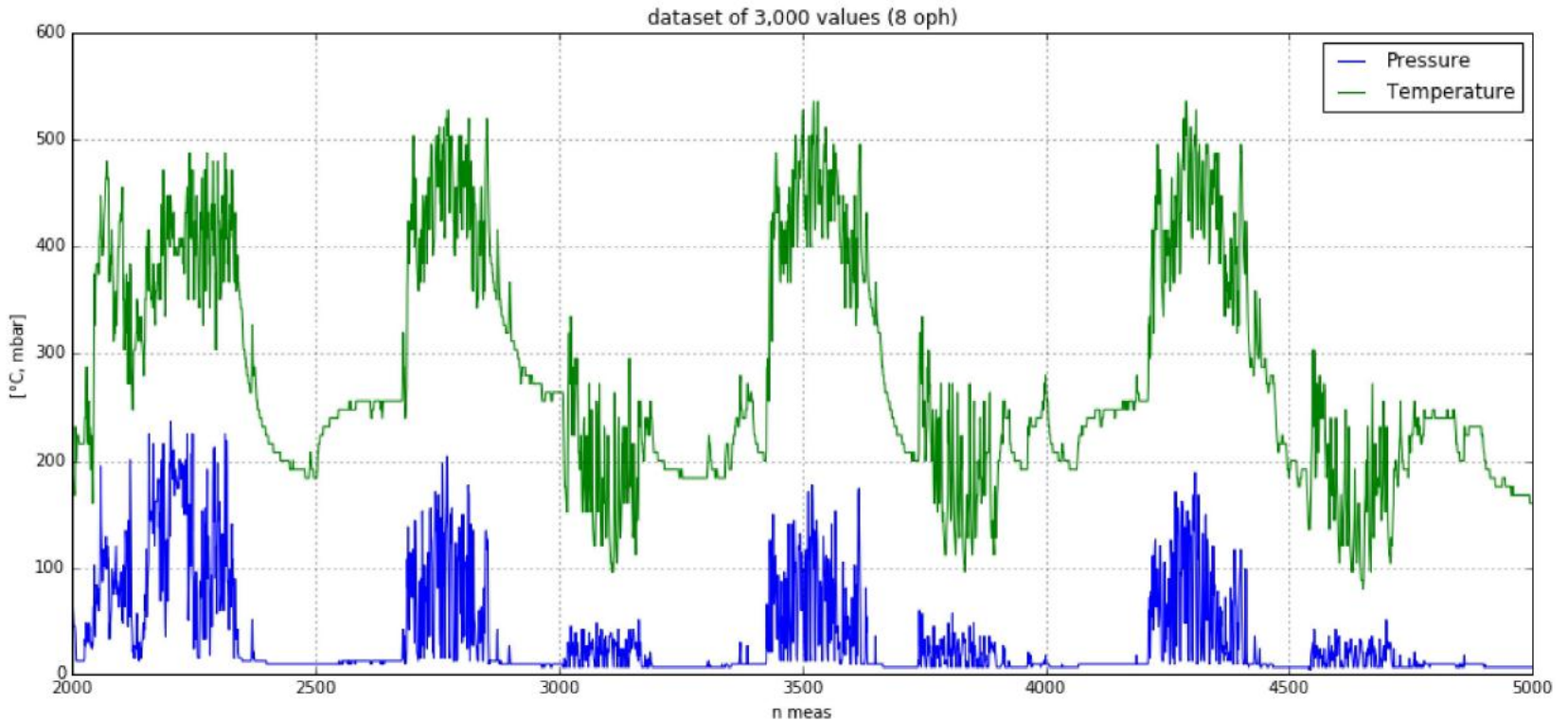
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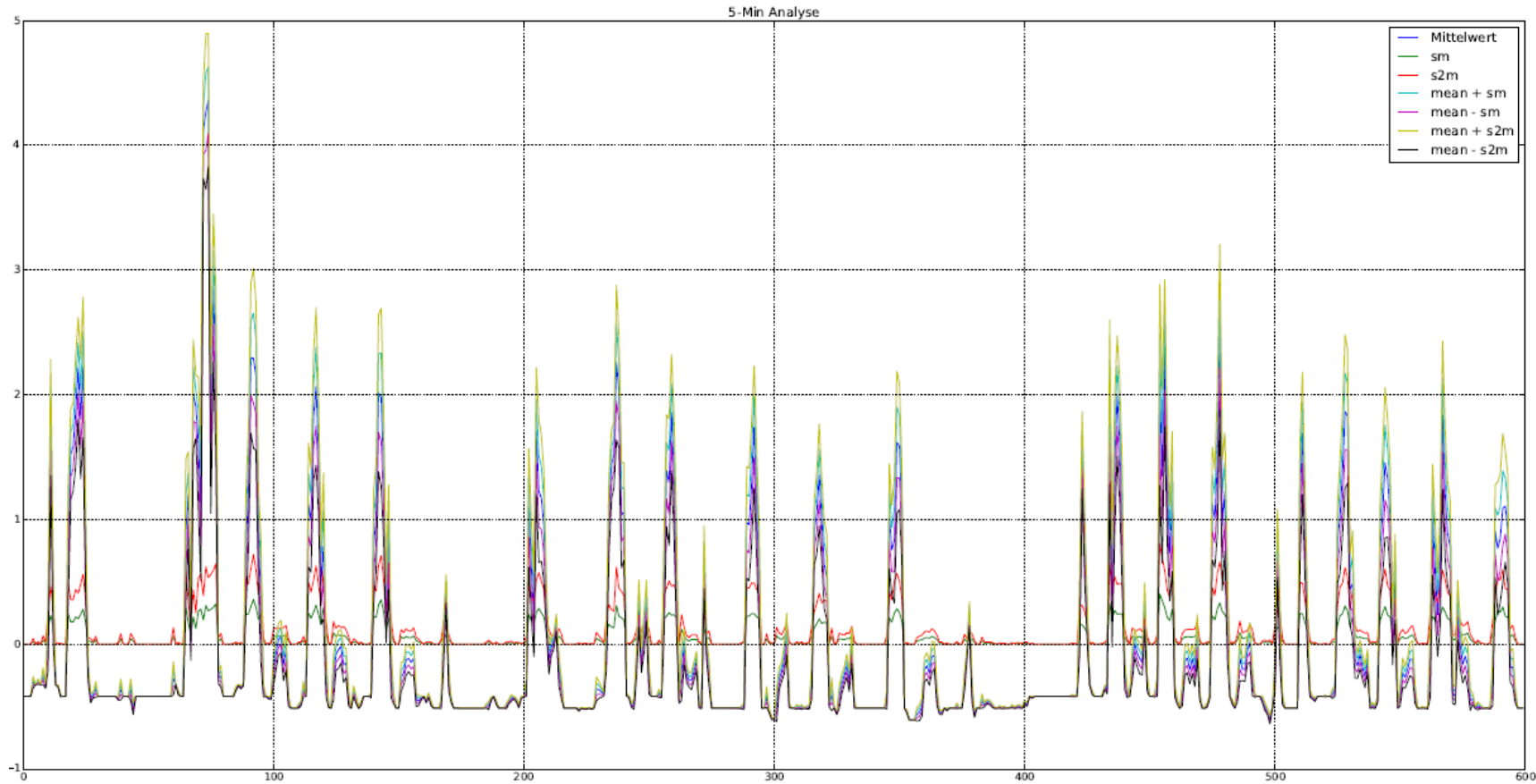
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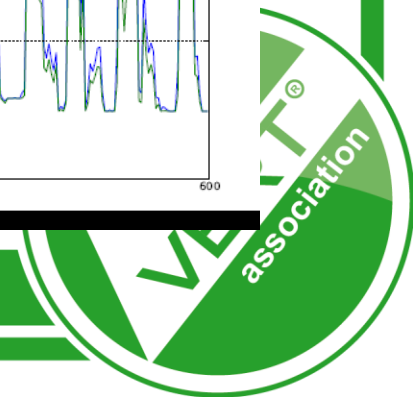
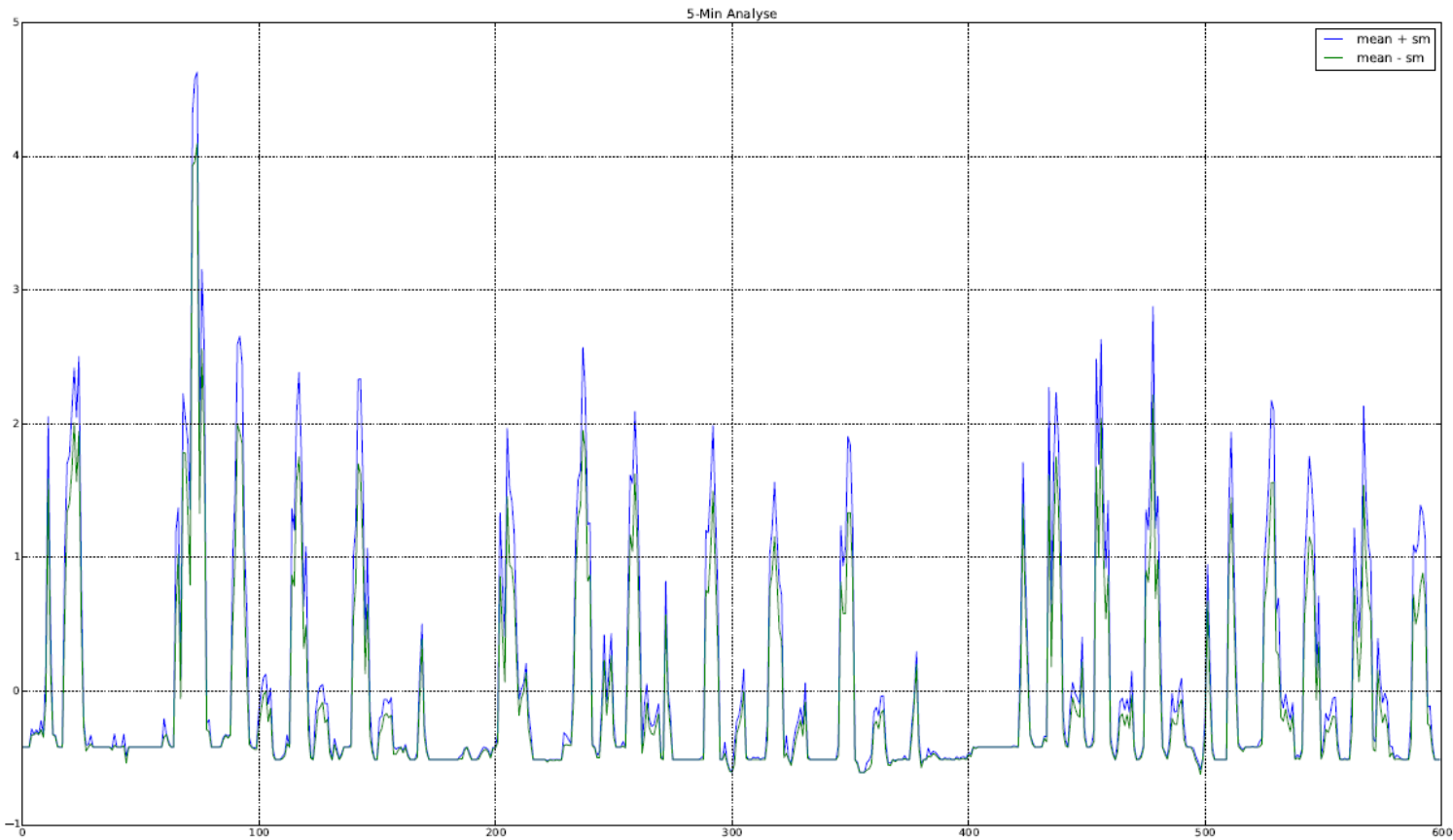
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How to go about?

Classic difference methods, 1st and 2nd differences

$$\Delta x = (x_t - x_{t-1}); \quad \Delta x / \Delta t = (x_t - x_{t-1}) / \Delta t; \quad \text{and} \quad \Delta^2 x / \Delta t^2$$

for trend analyses

intervall length decisive

long: for base line (ash)

short: slow falling - after reg.

slow falling reg. op. substrate defect

check crosscorr. Temp

second derivative: curvature: lube oil

2nd derivative: beyond classic m.



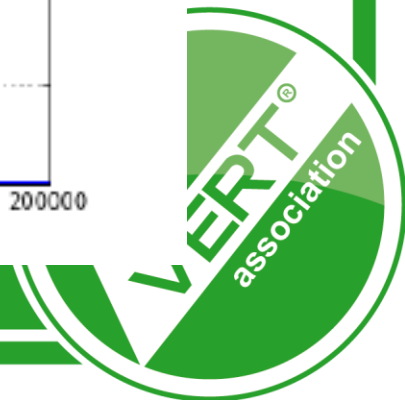
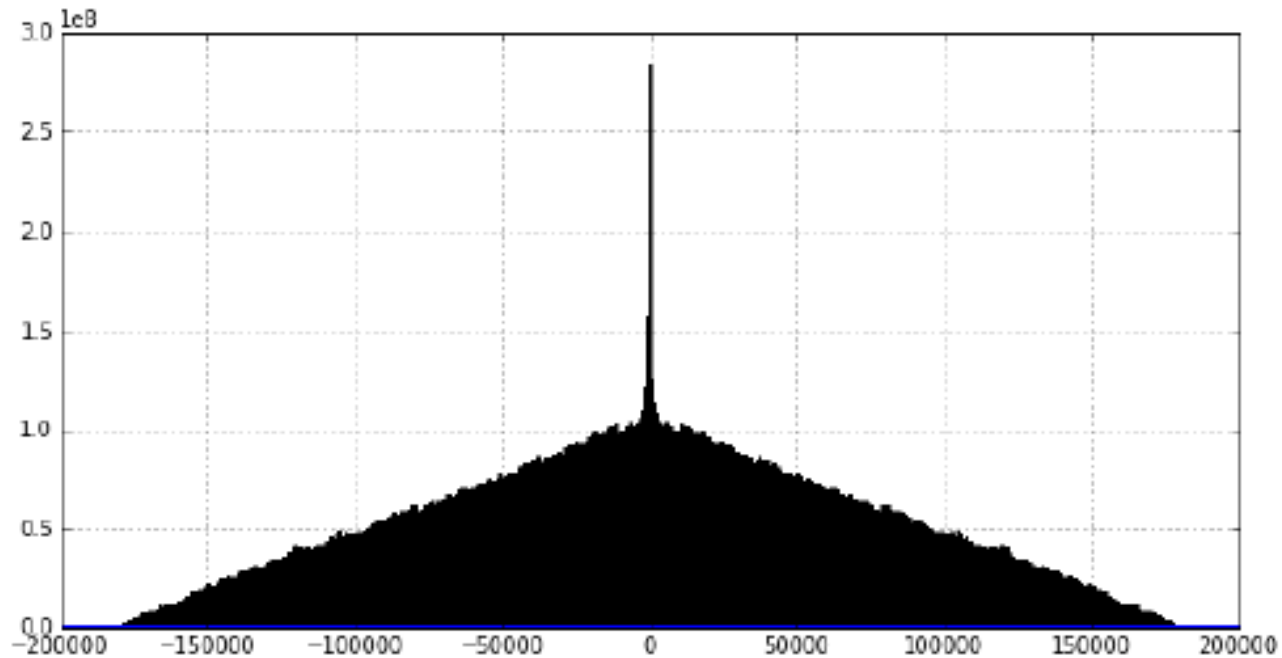
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W1, N > "Mittelwert + (2*Streuung)" 11,319

Autocorrelation 1:



Attempt - failure, two possible reasons:

- Transformation - standardisation according Poisson
- Too many irregularities of regeneration

First standardisation to be re-checked

Second, by means of higher order cross - correlation a periodicity of regeneration-peaks to be defined (scientific problem)

„mean-periodicity“ a necessity for analysis



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Expected time frame:

Classical methods: June 2016

Higher order methods: Sept.2016

Analyses of selected filters:

depending on interest: later on, all over
next year (i.e. 2017)



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Thank your for your patience!

