Use of proc similarity to compensate a delay in signal measurements

Tetyana Kholodna
Stavanger, FANS 2013
# Comparison of Time Series with Insecure Time Synchronization in the Data

<table>
<thead>
<tr>
<th>The customer's challenge</th>
<th>Our challenge</th>
<th>Our approach</th>
</tr>
</thead>
</table>
| • Monitor conditions of transmitters (measuring equipment)  
• Implement automatic fault detection methods as part of the monitoring system | • How to perform automatic fault detection in systems where equipment’s redundancy is not installed? Difference between values of two closely located transmitters shouldn’t be bigger than 3%.  
• How to decrease influence of delays? It can happen that both the transmitters work correctly but show very different values in short periods of time (usually in case of big changes of the signal and some delays in sending/receiving systems). | • Time series are used for either to confirm that the closely located transmitters behave the same way, or to find a failing transmitter. It is done through the comparison of trends and checking that the difference between the values is stable.  
• Check of the differences is carried out by using the "elastic" time series, which makes it possible to compare the time series with insecure time synchronization in the data. |
The SIMILARITY procedure computes similarity measures associated with time series. It’s based on Dynamic time warping technique which was developed to find an optimal alignment between two given (time-dependent) sequences under certain restrictions.
Use of Proc similarity to compare time series with insecure time synchronization in the data

The difference between two signals is huge, but we can see that actually both transmitters react on big changes of the signal similarly. The difference is big just because of delay.

After applying “elastic” time series approach, the difference between two transmitters’ signals is similar to previous values.
USE OF TIME WARPING TECHNIQUE HELPS TO RESOLVE THE TIME SYNCHRONIZATION ISSUE

There were drastic changes of both signals around 15:00
Red signals are coming down with a delay
Alarm system is built on analysis of difference between the signals
USE OF TIME WARPING TECHNIQUE HELPS TO RESOLVE THE TIME SYNCHRONIZATION ISSUE (CONT.)

without time warping

with time warping
Use of time warping technique helps to resolve the time synchronization issue (cont.)

Building of alarms for transmitters is based on hourly or daily check of statistics of the difference.

The statistics are sensible to such surges.

Combination of a surge and a time delay results in false alarms.

Using warping techniques allows to reduce considerably the influence of occasional delays.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>diff</td>
<td>0.5933953</td>
<td>0.8346610</td>
<td>0.0030654</td>
<td>6.9154070</td>
<td>69</td>
</tr>
<tr>
<td>metric</td>
<td>0.3540746</td>
<td>0.2807508</td>
<td>0.0030654</td>
<td>0.9676051</td>
<td>69</td>
</tr>
</tbody>
</table>
Tetyana Kholodna
Managing consultant, BIM
Capgemini Stavanger

Mob: 40002285
tetyana.kholodna@capgemini.com