Why not a Last Clear signal Aspect (LCA)?
Former Driver Advisory System (DAS)

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«LAST CLEAR ASPECT»
SIMULATIONS
CONCLUSION

Planned timetable
Telephone between dispatcher and stations
Real timetable and forecast
Pencils and ... eraser

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Pacing trains is already an old story
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Denmark
Germany
Netherlands
Sweden
Switzerland

ADL
Admirail
CATO
DSM
GreenSpeed
RoutLint
ZLR
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Computer-Aided Train Operation (CATO):
DAS ??? → ATO
Little remain: main driving phases

Most Restrictive static Speed Profile (MRSP)

- Acceleration
- Cruising
- Coasting
- Braking
Running in-time:
Highly dependent on the experience of the driver

Normal driving style: appropriate use of the performance margin
- to coast at the appropriate places,
- to brake essentially with the regenerative brakes

Objectives:
- arrival on time
- energy savings, wear & tear savings, passenger comfort increase
Running late in case of catching up:
Highly dependent on the experience, on the knowledge and on the driving style of the driver

V₂ > V₁  First catching up:

V₂ < V₁

V₂ << V₁
Running late in case of catching up:
The “intermediate” phase

\[ V_2 << V_1 \]

Slow speed phase:

\[ V_2 << V_1 \]
Running late in case of catching up:

The speeding up phase

“offensive” driving style:

A very quickly new catching up

“no stress” driving style:

A slow new catching up
Running late in case of catching up:
The help of the last clear signal aspect before braking

First catching up:

\[ V_2 \approx V_1 \]

\[ V_2 > V_1 \]

\[ V_2 < V_1 \]
Running late in case of catching up:
The help of the last clear signal aspect
during the “intermediate” phase

\[ V_2 < V_1 \]

Slow speed phase:

\[ V_2 < V_1 \]

V1

V2

\[ V_2 \rightarrow \uparrow \]
Running late in case of catching up:
The help of the last clear signal aspect before speeding up

“Last clear aspect” driving style:
SNCF – BAL Automatic “4”-aspect signaling system

2 wires from …

2 wires for …

Blinking unit

From “Signalisation ferroviaire” – R. Rétivau (SNCF) – 1987
**THEORETICAL**

“last clear aspect” adv./cons. in case of train succession

<table>
<thead>
<tr>
<th>Effect of a “last clear” indication on ...</th>
<th>ATP without release loop or beacon</th>
<th>AWS or ATP with release loop or beacon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free flow / Timetable stability</td>
<td>Very good</td>
<td>Good</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>Very good (Good for EMU)</td>
<td>Good (No for EMU)</td>
</tr>
<tr>
<td>Stress of the driver</td>
<td>Very good</td>
<td>Good</td>
</tr>
</tbody>
</table>

from “Simple ways to pace trains” – D. Emery (EPFL) ICIRT-2013 (Pékin)
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Line length:
Approximately 60 km (Lausanne-Genève)
Speed profiles, number of intermediate stops, and mean distance between them:
ICN(0, 60km), IC(0, 60km), IR(2, 20km), Freight(0, --), RE(7, 9km), Freight-D(0, --)
Max Speed, Braking Weight Percentage:
- ICN (160km/h, N180%), IC/IR (140km/h, R135%),
- Freight (100km/h, A115%), RE (140km/h, R135%),
- Freight-D (80km/h, D)
IC First, ICN “offensive”

First + 10 supplementary brakings

Distance
IC First, ICN “no stress”

$t_{ICN-O} = t_{REF}$

First + 1 supplementary braking
IC First, ICN “LCA”

\[ t_{ICN-O} < t_{ICN-LCA} < t_{ICN-NS} \]

(O+25 sec \[ < \] O+51 sec)

First + 2 supplementary brakings

Distance
RE First, G “offensive”

First + 9 supplementary brakings

Speed

Distance

0 1 2 3 4 5 6 7 8-9

RE

G
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RE First, G "no stress"
A115%-RE : 46:38LCA
45:55-D 46:08-O

1+2 supplementary brakings
**RE First, G “LCA”**

\[ t_{G-NS} < (!!) t_{G-O} < t_{G-LCA} \]

(NS+13 sec  NS+43 sec)

First + 5 supplementary brakings

\[ C = \text{Coasting} \]
Last clear signal aspect → Anticipation →
Energy savings, Less stress

Last clear signal aspect → Driving style standardization →
Optimization of the capacity use?

Thank you for your attention
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CONTACT & BIBLIOGRAPHY


T. Albrecht, TUD, "Understanding Energy-Efficient Driving as Predictive Control", Presentation Document, Faculty of Transportation and Traffic Sciences, Dresden University of Technology, about 2007

