

Informal document No. **9**
(50th GRE, 7-11 April 2003,
agenda item 3.2.)

“CUT-OFF” LINE IN AFS DRAFT REGULATION

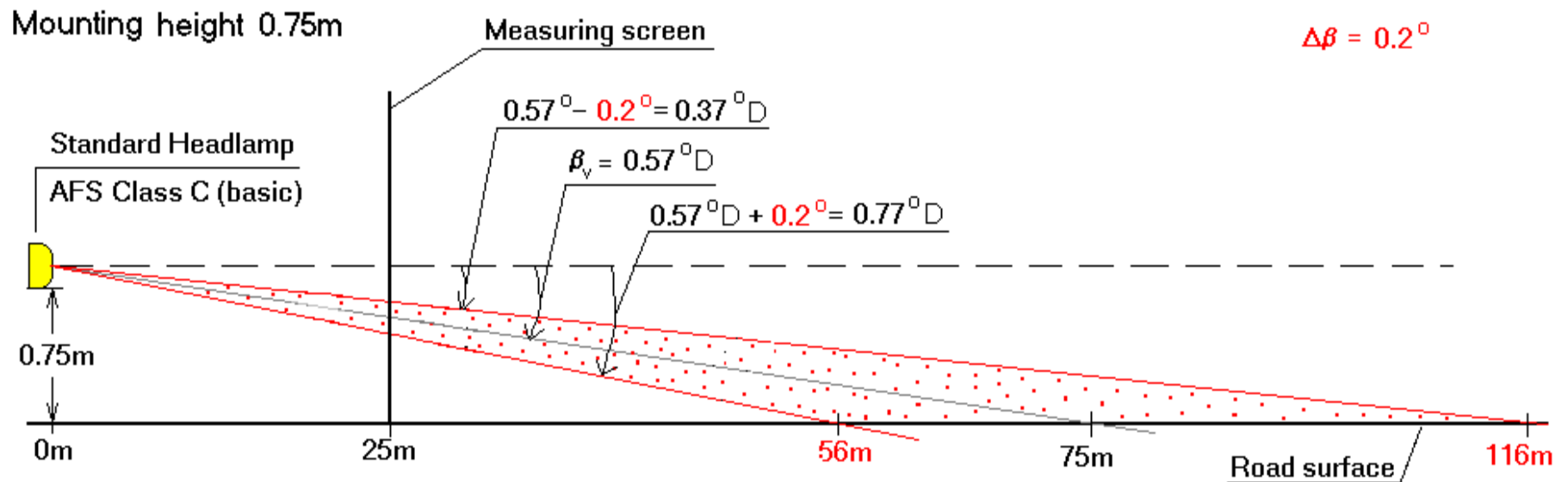
EXPLANATION TO INFORMAL DOCUMENT No. 8

Tomasz Targosiński

Poland

This document is distributed to the Experts on Lighting and Light-Signalling only.
The document as a whole or in parts cannot be used for other purposes than GRE without written permission of the author.

INFLUENCE OF TOLERANCES OF VERTICAL AIMING ON LIGHTING RANGE AFS CLASS C (BASIC) PASSING BEAM



According to Draft XXX proposals:

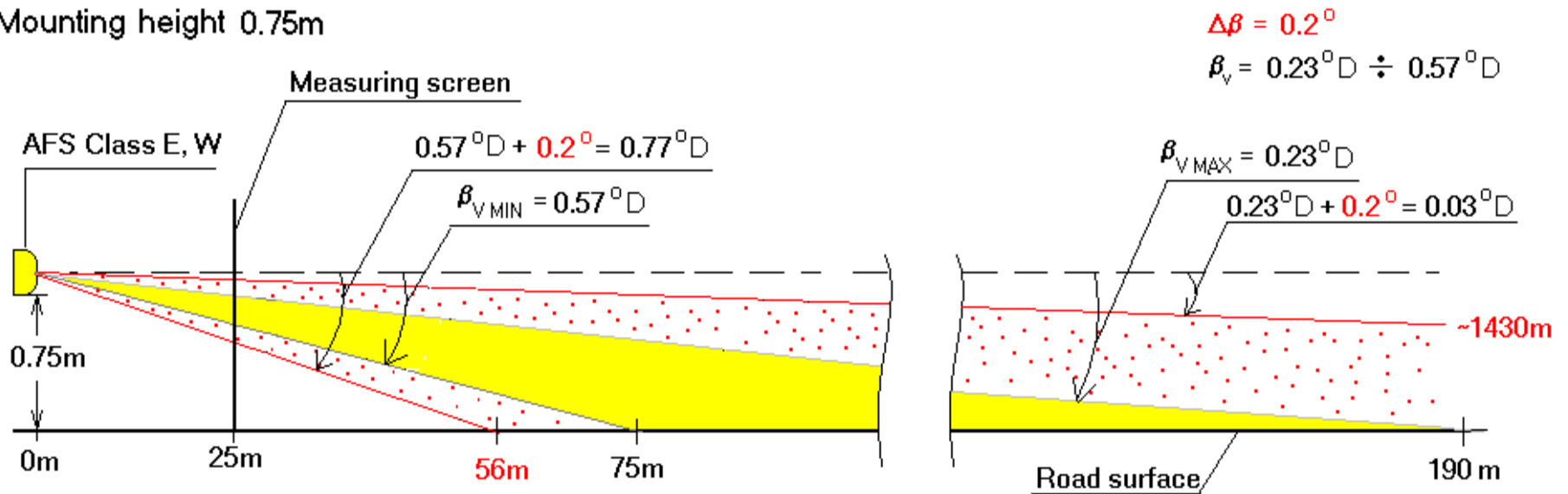
- Annex 9 P. 1.2.1. the "horizontal part" does not exceed a vertical extent of $\Delta\beta = 0.2 \text{ deg}$ up or down*
- Annex 3 Table 2 Class C (basic): the "cut-off" shall be positioned at 0.57 deg*

In case of using a standard headlamp at standard mounting height at 0.75m, assuming „cut-off” line tolerance of $\Delta\beta = 0.2 \text{ deg}$, lighting range will vary 56m to 116m, which can be accepted.

INFLUENCE OF TOLERANCES OF VERTICAL AIMING ON LIGHTING RANGE

AFS CLASS E (MOTORWAY) AND CLASS W (WET ROAD) PASSING BEAM

Mounting height 0.75m



Accordinging of Draft XXX proposal:

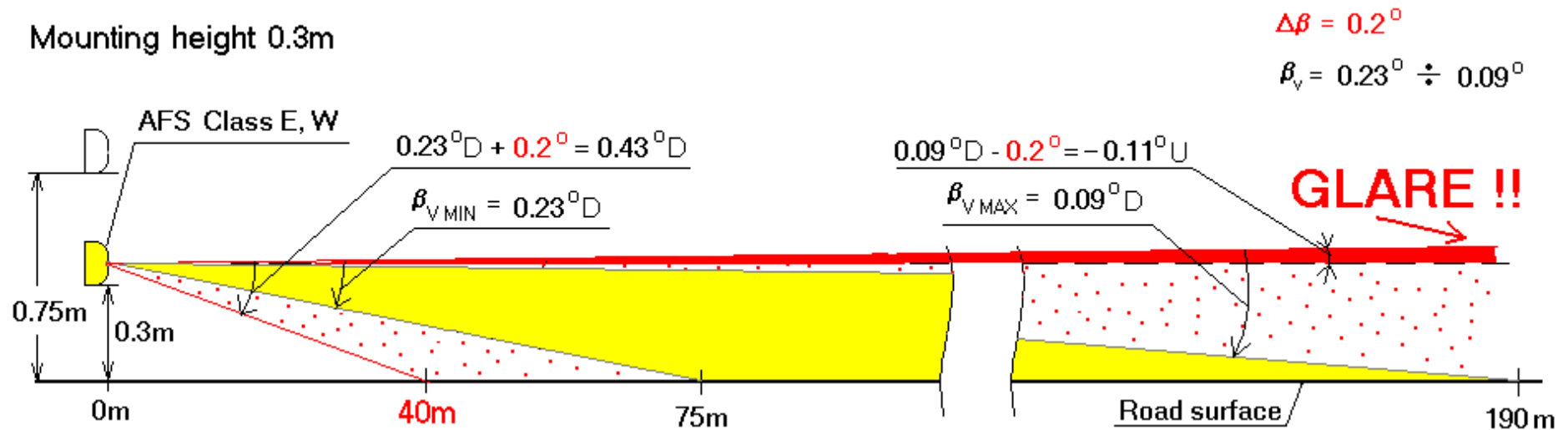
Annex 3 Table 2 Class E (motorway) and W(wet road):

the "cut-off" shall be positioned not above 0.23deg and not below 0.57deg

In case of using AFS Class E and W passing beams of one pair of lighting units **at standard height of 0.75m**, lighting range will vary from 56m to 1430m (considering rising of the beam from 0.57degD to 0.23degD) when tolerance of vertical aiming is **$\Delta\beta = 0.2\text{deg}$** .

INFLUENCE OF TOLERANCES OF VERTICAL AIMING ON LIGHTING RANGE

AFS CLASS E (MOTORWAY) AND CLASS W (WET ROAD) PASSING BEAM



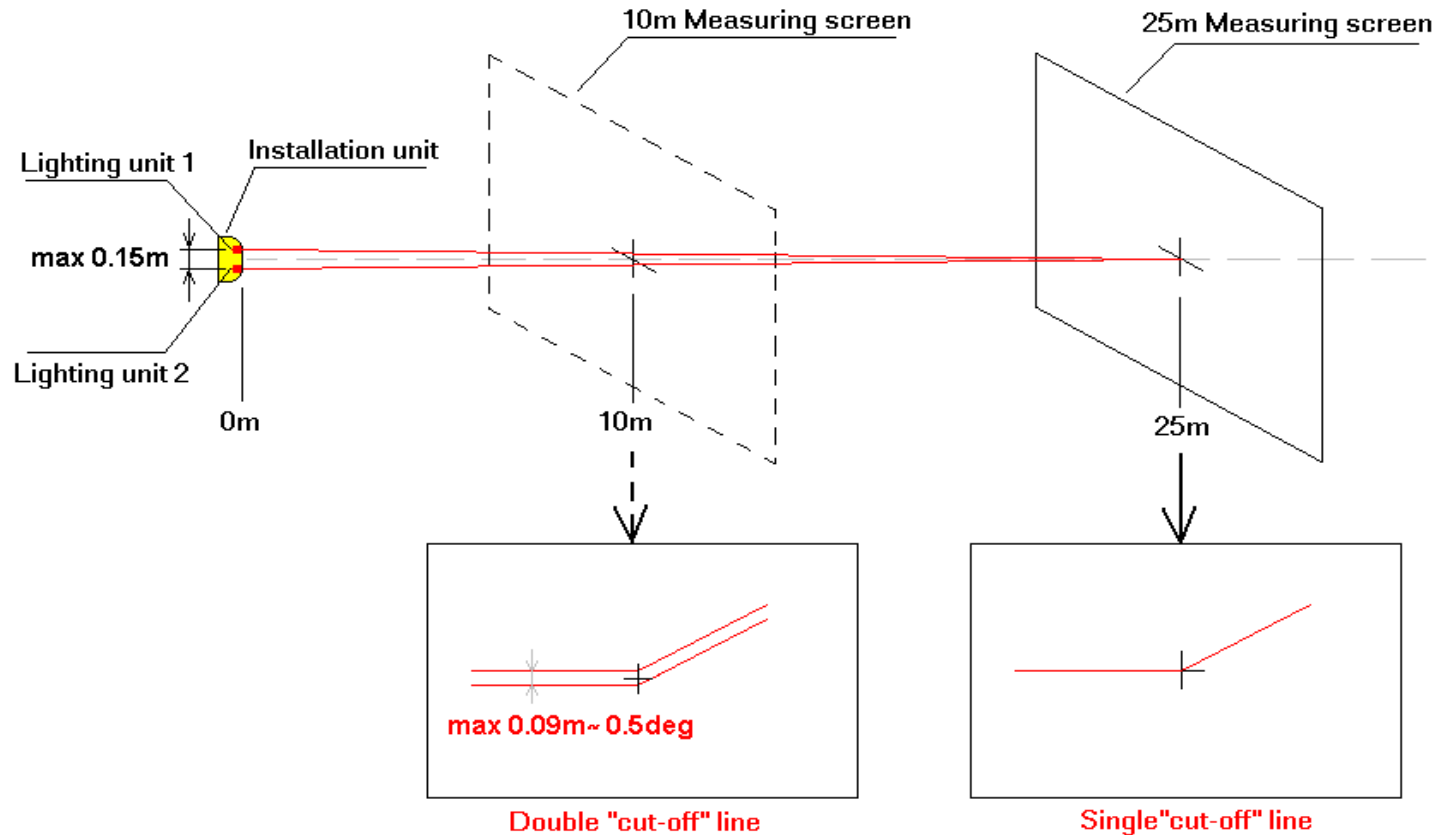
To obtain **the same lighting range** for AFS lighting units mounted at **0.3m** as for AFS lighting units mounted at standard mounting height 0.75m, the “horizontal part” shall be positioned not below $0.23\text{deg}D$ and not above $0.09\text{deg}U$.

Problems considering $\Delta\beta = 0.2\text{deg}$:

- lighting range on the road surface can change from 40m to „infinity”
- „cut-off” can be positioned over $0.43\text{deg}D$ and under $0.11\text{deg}U$ over horizon. This can cause direct intensive glare

Conclusion: „Horizontal part” of „cut-off” shall be aimed with tolerance of not more than $\Delta\beta = 0.1\text{deg}$.

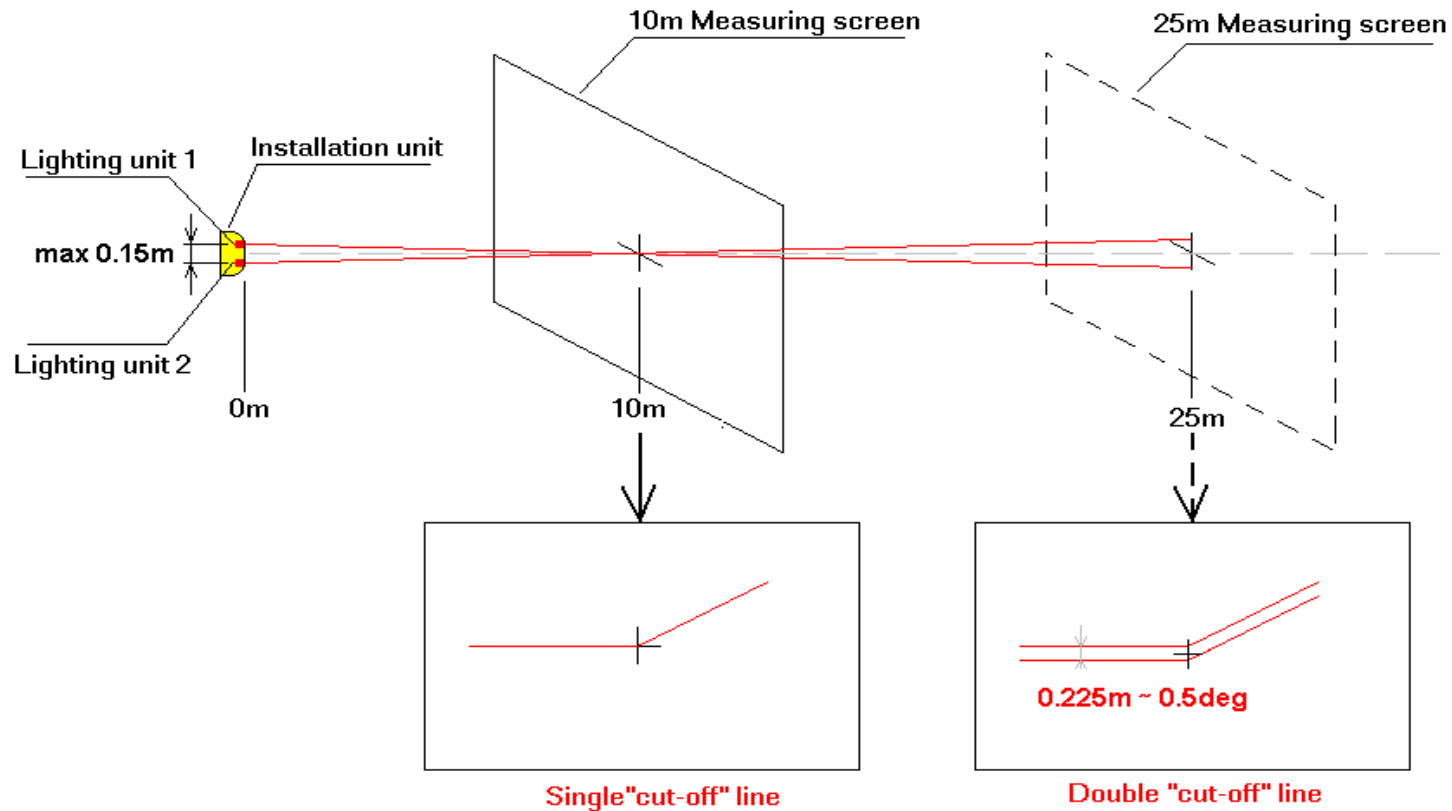
DOUBLE „CUT-OFF” LINE PHENOMENON AIMING ON 25M MEASURING SCREEN



Accordinging of Draft XXX proposal:

Annex 9 P.3.1. Measurements of the illumination E on the aiming screen are performed by vertical scanning through the "horizontal part" of "cut-off"(...) at a 10 m distance or at any greater distance ...

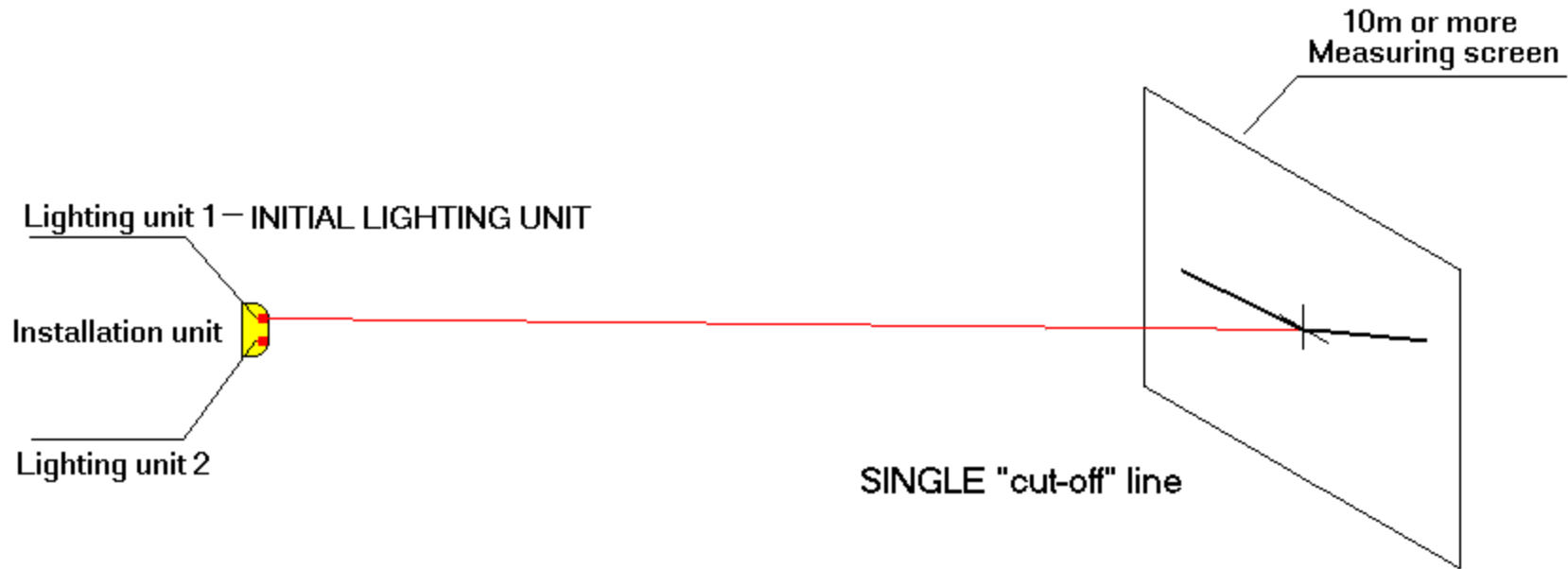
DOUBLE „CUT-OFF” LINE PHENOMENON AIMING ON 10M MEASURING SCREEN



Double „cut-off” line can be the result of projection of „cut-off” lines coming from two or more lighting units.

Conclusion: “Cut-off” line of each lighting unit, and not “cut-off” line of passing beam or installation unit, has to be aimed separately to avoid multiple „cut-off” line problem.

PROPOSAL OF OF “CUT-OFF” LINE AIMING BEFORE MEASUREMENTS



New definition: INITIAL LIGHTING UNIT - lighting unit specified by an applicant used for aiming the „cut-off” line before photometric measurements (TRANS/WP.29/GRE/2002/44rev.1)

Suggested procedure of aiming of the “cut-off” line:

1. Aiming the „cut-off” line for initial lighting unit.
2. Measuring the illumination E for lighting units incorporated in installation unit and not separately aimed.

AMBIGUITIES OF „CUT-OFF” LINE DESCRIPTION IN DRAFT XXX

In many places of Draft XXX there is no clear distinction between “cut-off” line of **passing beam** and “cut-off” line of **lighting unit** e.g.:

Accordinging of Draft XXX proposals:

Annex 9 P.1. The "cut-off" line of a passing beam shall comply with the following requirements ...

Annex 9 P.2.1 For lighting units contributing to the passing beam but providing no “cut-off” or a horizontal “cut-off” line only ...

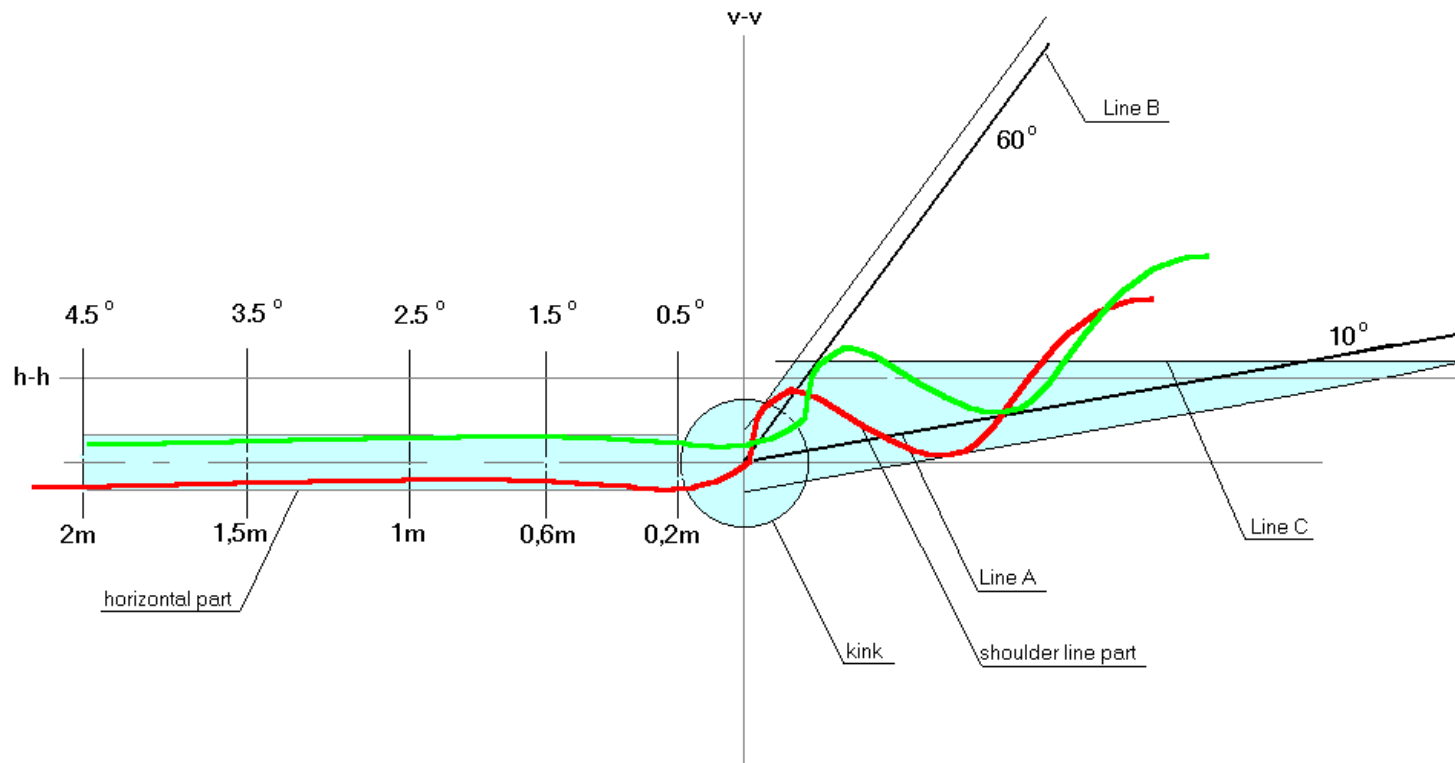
Annex 9 P.2.3. For each class, other than the class C (basic) passing beam: the shape and position of the "cut-off", if any, shall comply ...

Conclusion: Description of “cut-off” line of lighting unit should only be used.

COMMENTS AND SUGGESTIONS

- P.1.1. The "cut-off" line shall consist of (...)
(iii) one clear "kink",
[ambiguous definition]
- P.1.3. If there is no distinct "kink", the "kink point" shall be considered to be that point, where the 60 deg tangential line to the "shoulder line part" (...)
[proposal in TRANS/WP.29/GRE/2002/44 rev.1]
- P.1.2.1. ... "horizontal part" does not exceed a vertical extend of $\Delta\beta = 0.2$ deg up or down within 0.5 deg and 4.5 deg left from the "kink"; ...
[proposal in TRANS/WP.29/GRE/2002/44 rev.1]
- P.2.2.1. If the "horizontal part" of the "cut-off" line does not provide sufficient linearity and/or sharpness for a visual vertical adjustment the "cut-off" quality shall be evaluated for compliance with provisions laid down in paragraph 3. below, according to the discretion of the Technical Service.
[ambiguous description]
- P.3. "cut-off" quality evaluation:
P.3.1. ... After visual horizontal adjustment according to paragraph 2.1. above, the scanning is done at 1.5 deg, 2.5 deg and 3.5 deg left of V-V.
[proposal in TRANS/WP.29/GRE/2002/44 rev.1]

RESULTS DEPENDING ON USAGE OF „SHOULDER LINE PART” TOLERANCES



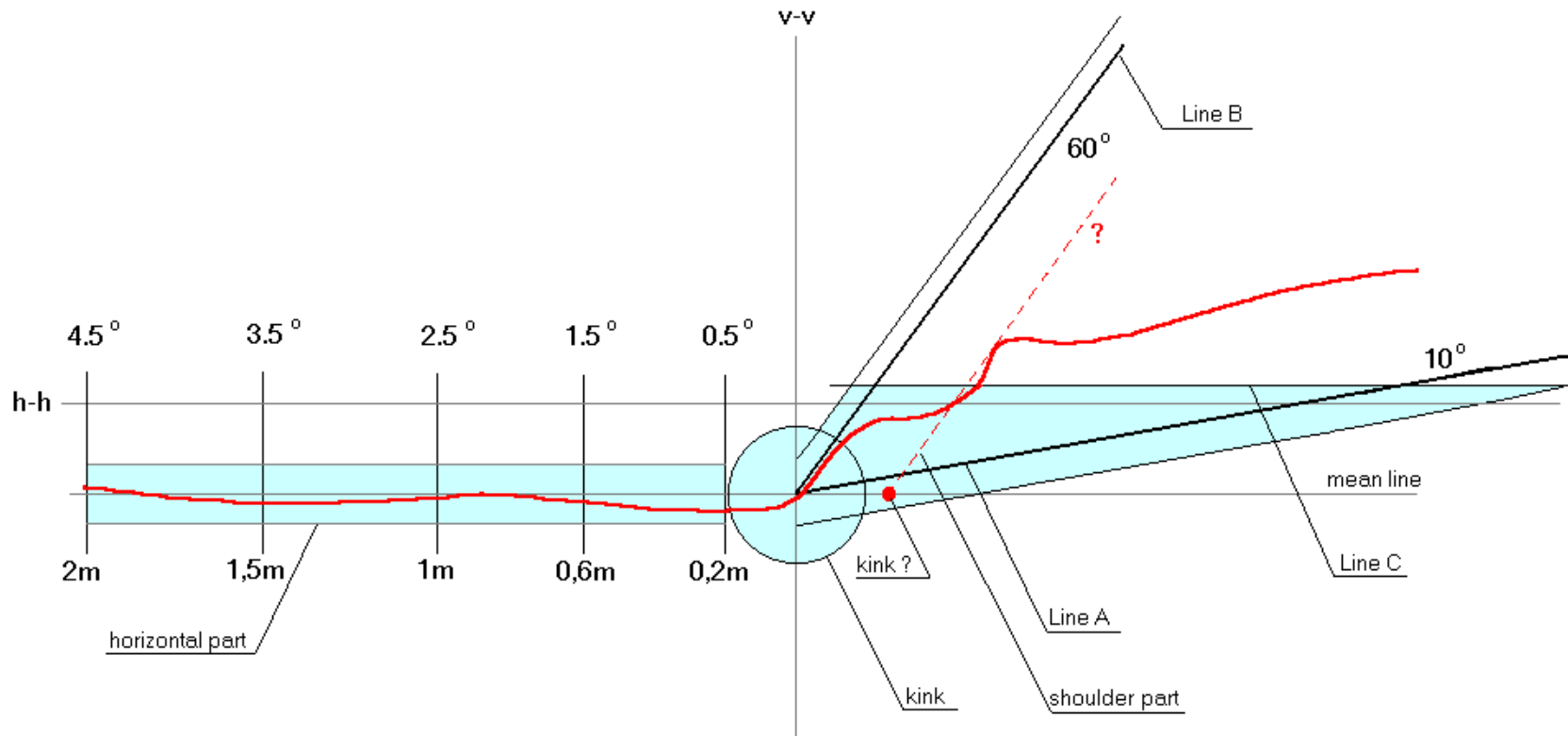
„Cut-off” line can be aimed differently depending on using or not using 0.2 deg tolerance of A and B lines:

1. If tolerances of lines A and B do not apply, green position “cut-off” line is obtained.
2. If tolerances of lines A and B apply, red position “cut-off” line is obtained.

Conclusion: Tolerances of A and B lines $\pm\Delta\beta$ lead to different results of „cut-off” line aiming.

Proposal: **Remove A and B lines $\pm\Delta\beta$ tolerances from Draft XXX.**
(as in TRANS/WP.29/GRE/2002/44rev.1)

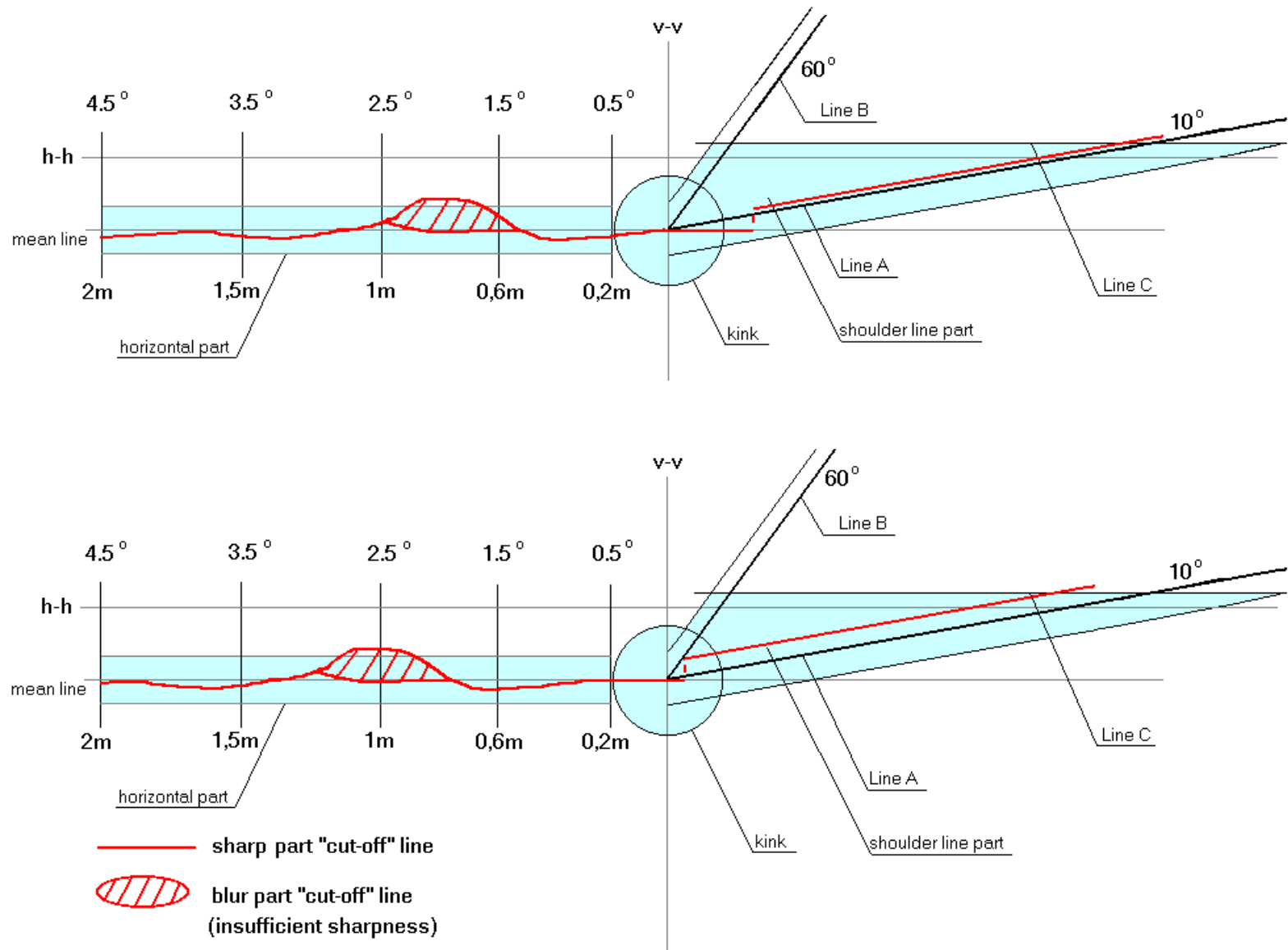
POSITION OF 60DEG TANGENTIAL LINE



Some of lighting units can have more than one „kink point” in „cut-off” line and it is difficult to decide which one is correct with respect to the tangential line inclined 60 deg to the „shoulder line part”.

Proposal: „Shoulder part” shall be approximated by slant line.
 (Compare examples of “cut-off” line approximation)

RESULTS OF DISCONTINUITY (THRESHOLD) OF „SHOULDER LINE PART”



RESULTS OF DISCONTINUITY OF „SHOULDER LINE PART”

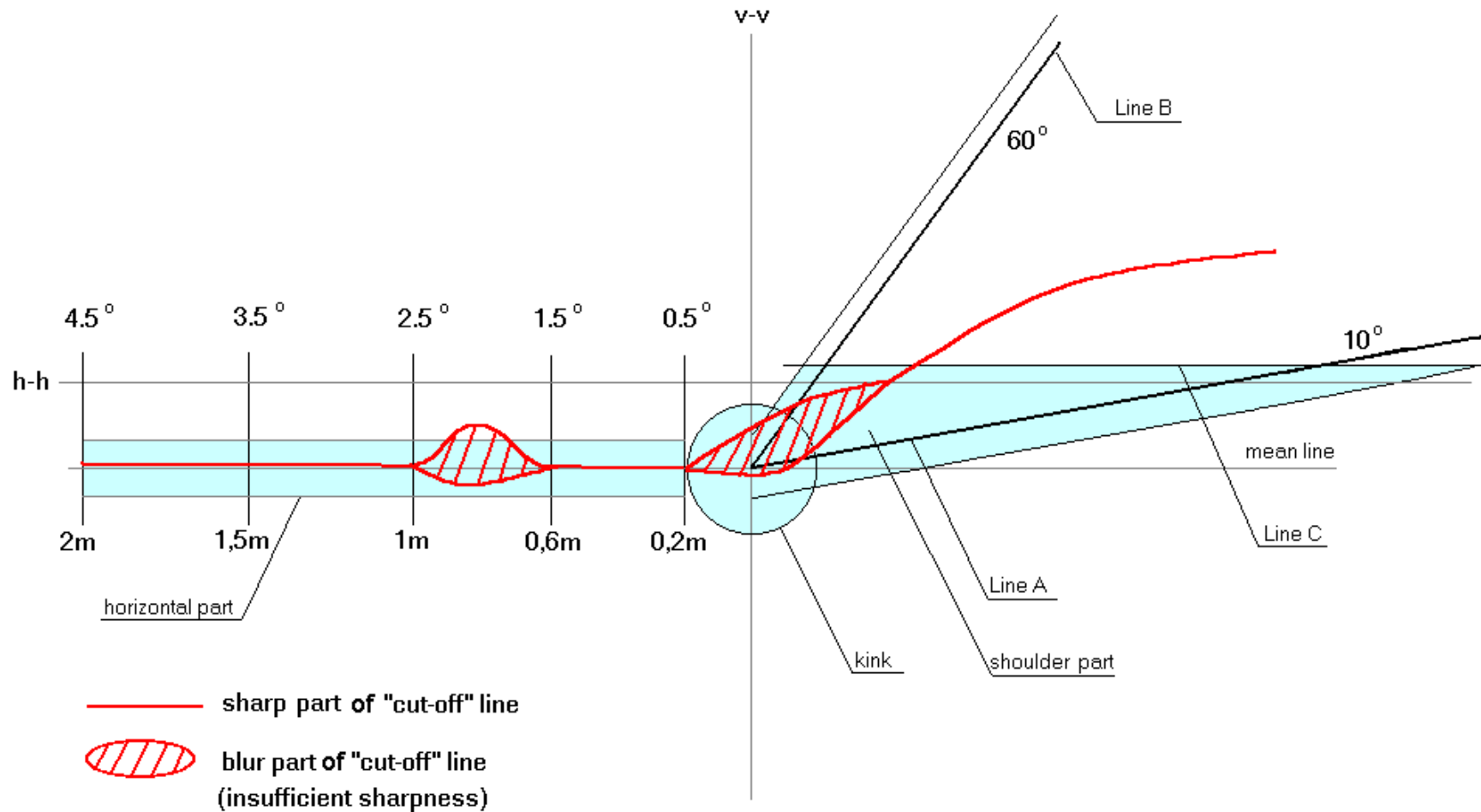
If there is discontinuity on the „shoulder line part” of „cut-off” line, there are two different possible ways of finding „kink point”:

- using visual approximation by prolonging slant part of „cut-off” line
- using 60deg tangential line

According to Draft XXX the quality of horizontal part of „cut-off” is checked in three points (1.5deg, 2.5deg, 3.5deg) only. Results will depend on this way.

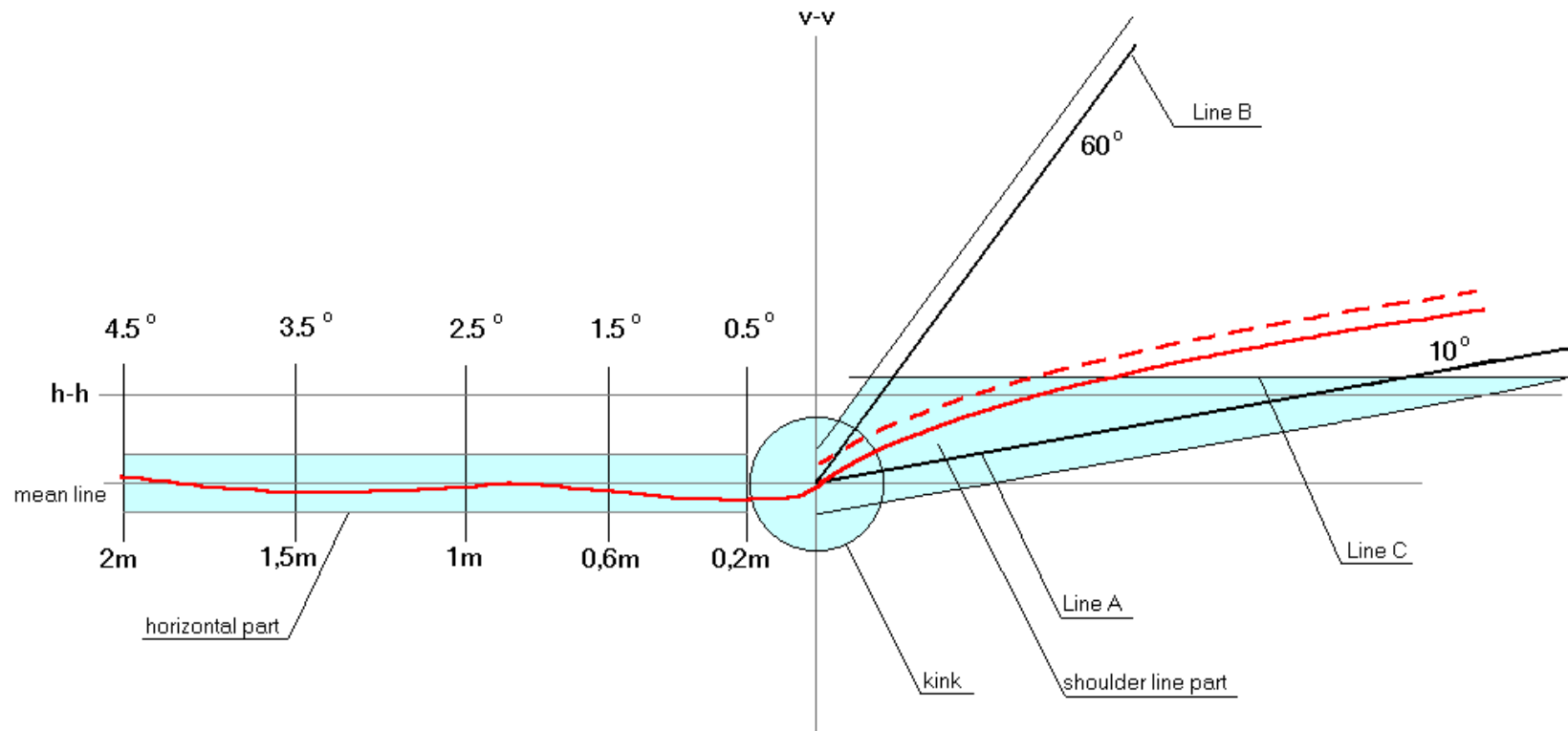
Conclusion: If “horizontal part” of „cut-off” line has small blur part, then in one situation
_____ the „cut-off” line quality can be estimated as correct and in the other as
_____ incorrect depending on chosen way of finding „kink point”.

BLURRED „KINK POINT”



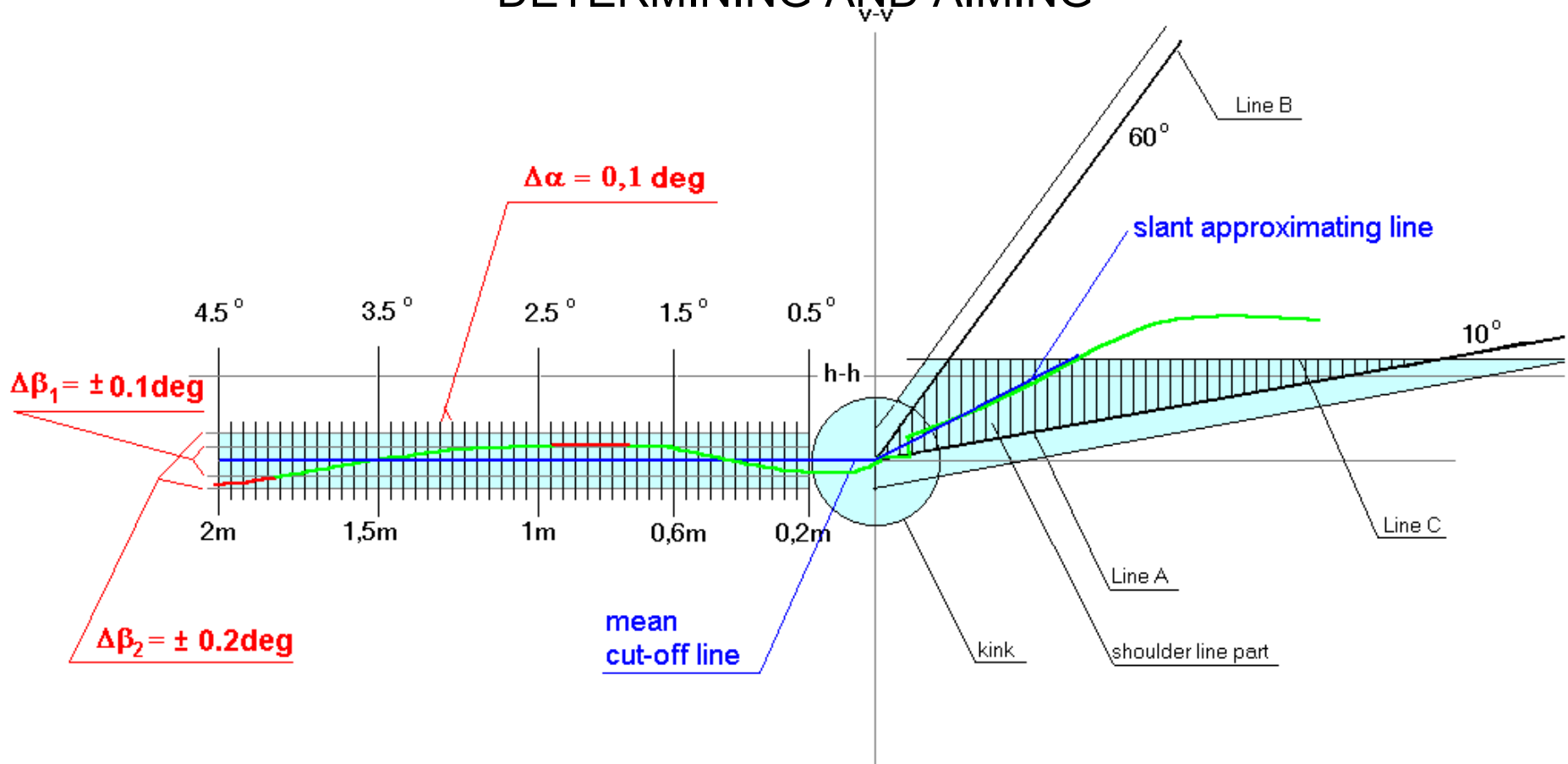
If the „kink point” is blurred it is difficult to locate correct place of „kink” and conclusion is similar to the previous example.

DOUBLE „SHOULDER LINE PART”



If there is a double „shoulder line part”, there is a double „kink point”.

PROPOSAL OF IMPROVING THE METHOD OF CUT-OFF LINE DETERMINING AND AIMING



Proposals of changes:

1. Vertical scanning „cut-off” line every 0.1deg
2. Tolerance range of the most „horizontal part” should be ± 0.1 deg.
3. 80% of „horizontal part” should be placed within ± 0.2 deg tolerance range.
4. „Shoulder line part” should be approximated by slant line.

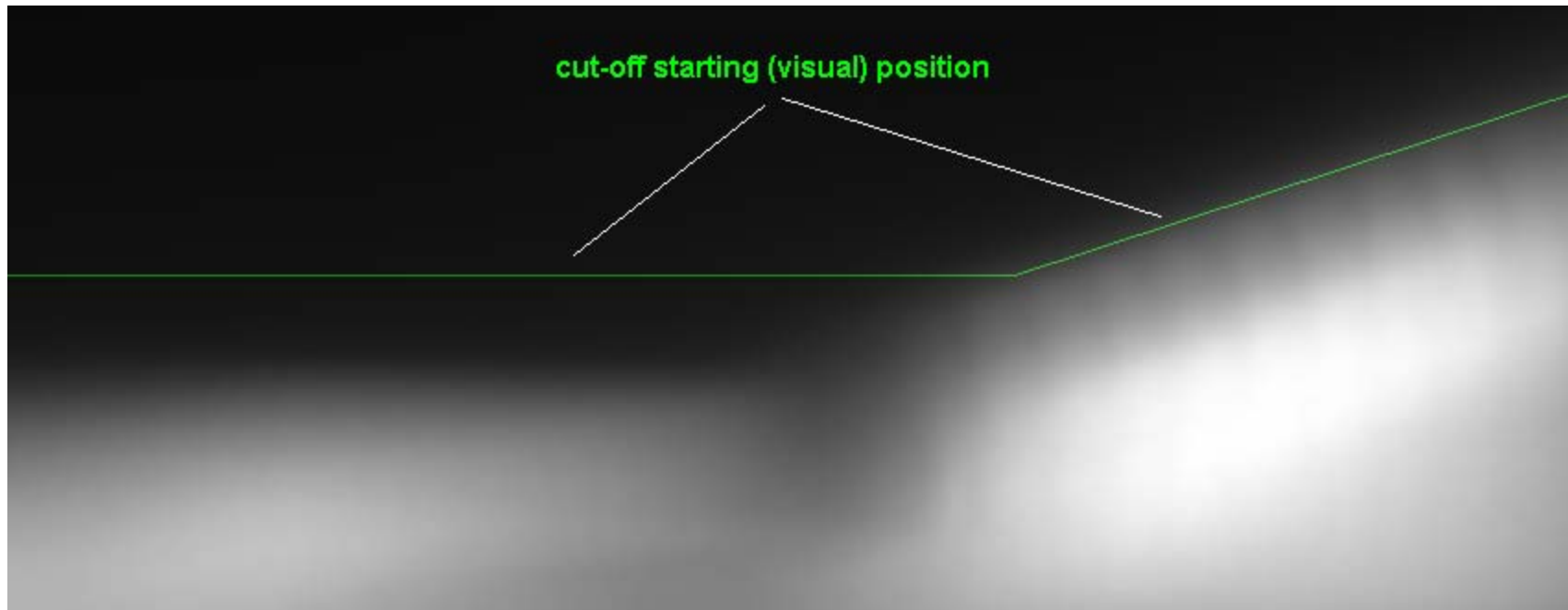
THE PROCEDURE OF INSTRUMENTAL ADJUSTMENT OF „CUT-OFF” LINE

EXAMPLE

as proposed in TRANS/WP.29/GRE/2002/44 Rev.1

VISUAL PRE-AIMING

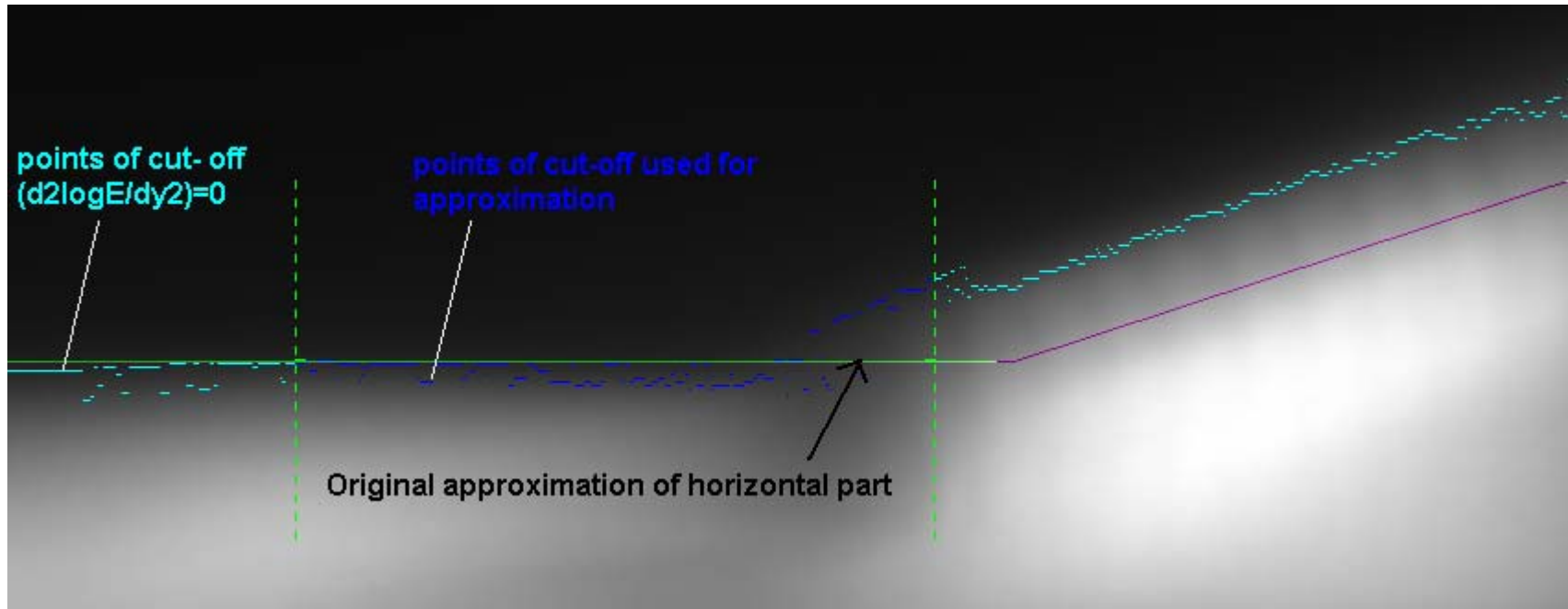
VISUAL APPROXIMATION OF „CUT-OFF” LINE



Remark: Even if visual pre-aiming is not enough precise, the result of the proposed procedure will be correct.

FIRST VERTICAL ADJUSTMENT

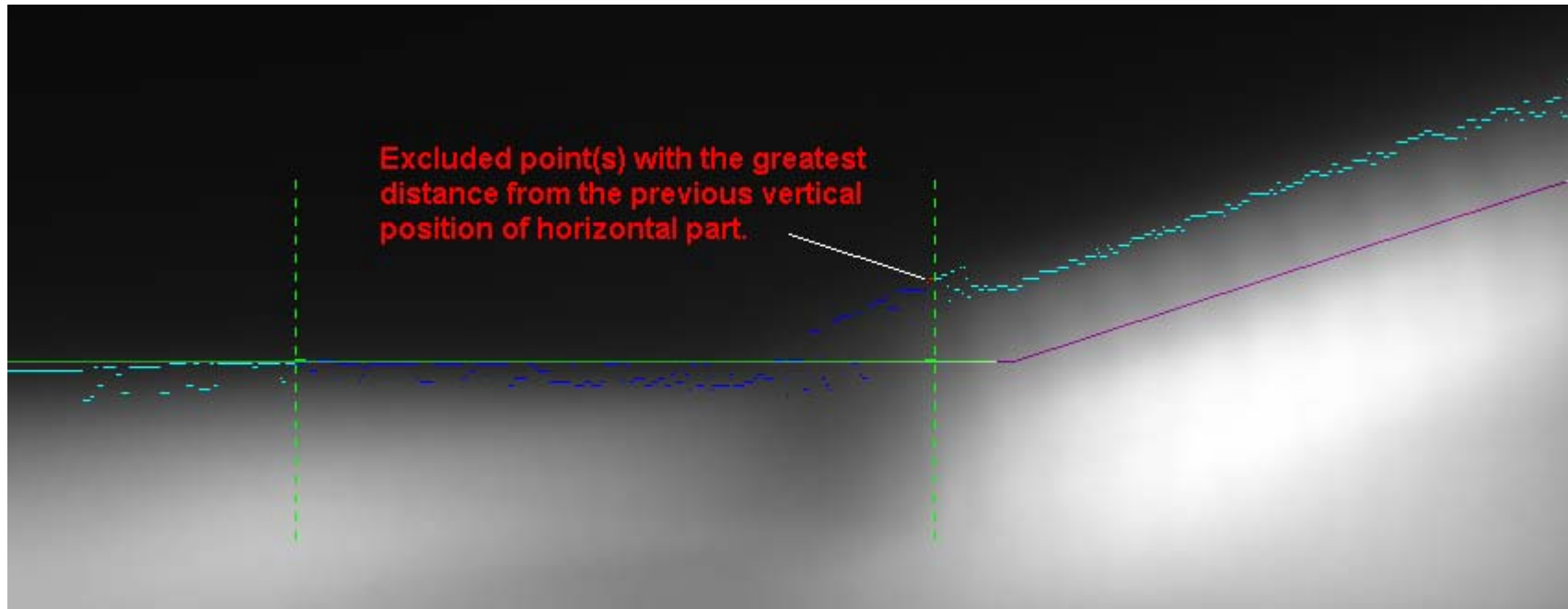
ORIGINAL STEP OF THE LOOP



Determining original approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.1.

FIRST VERTICAL ADJUSTMENT

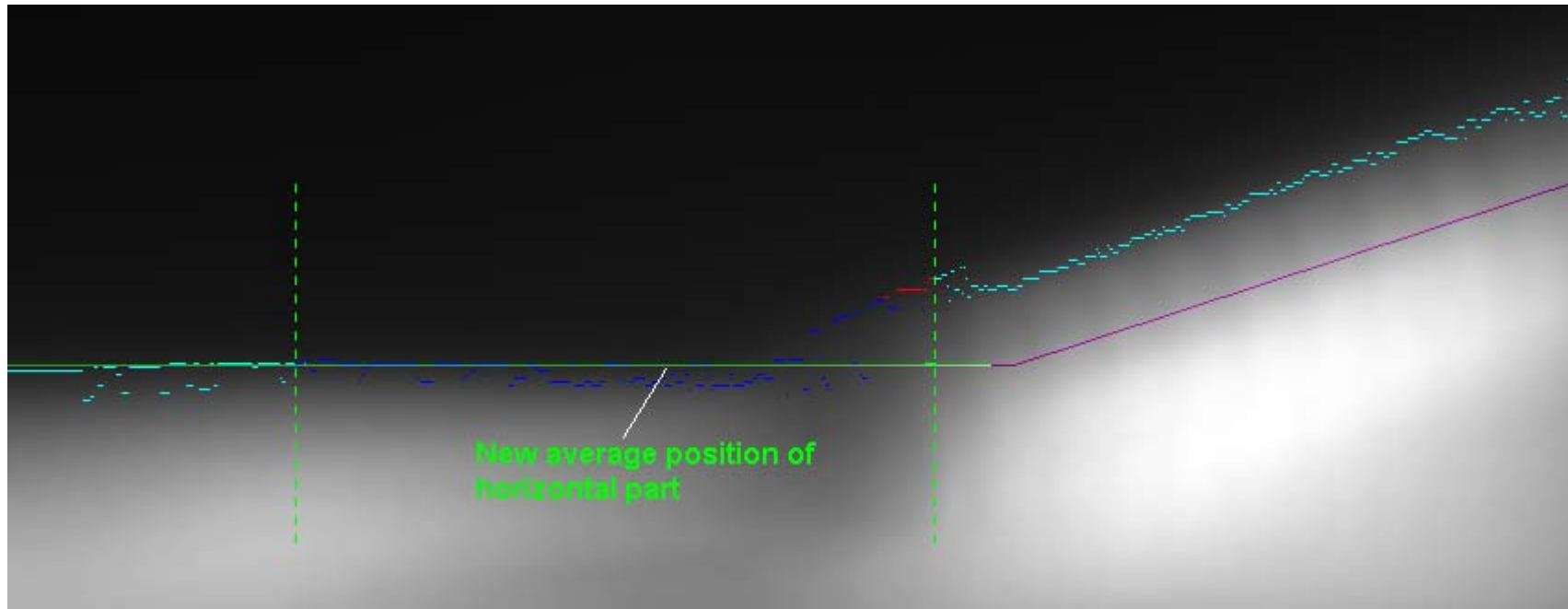
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.2.

FIRST VERTICAL ADJUSTMENT

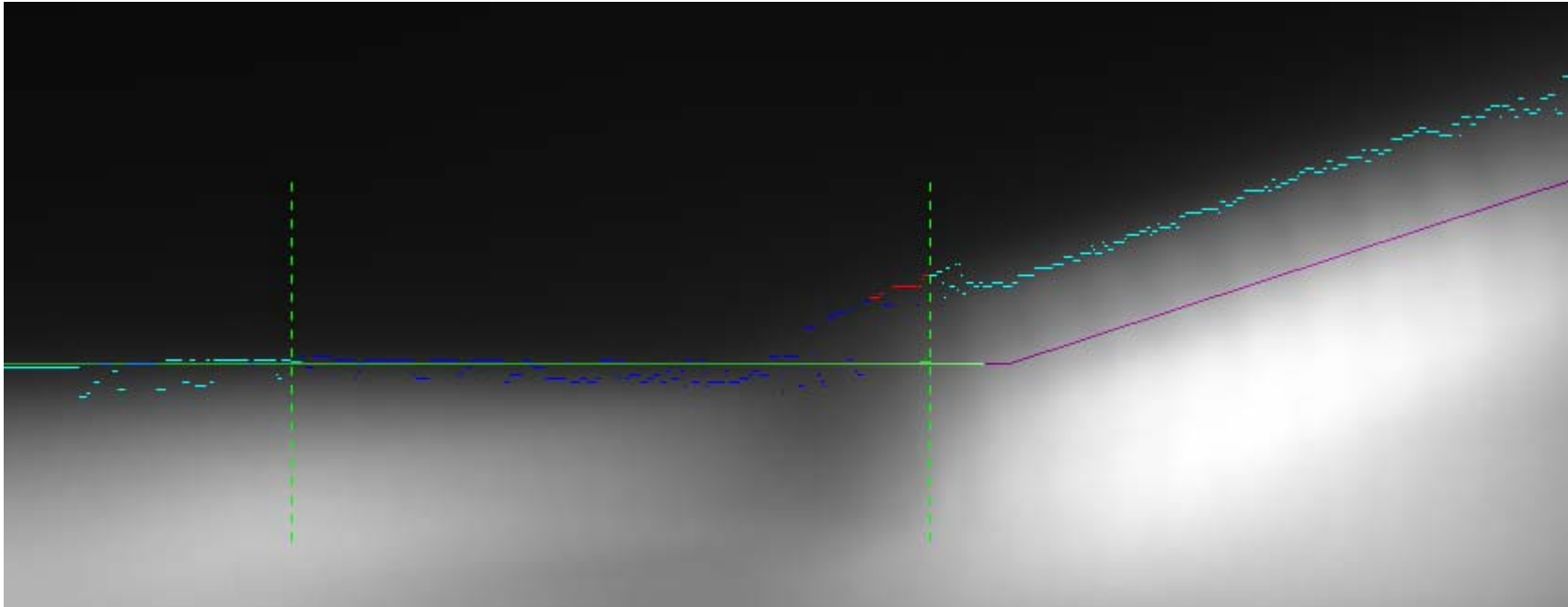
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

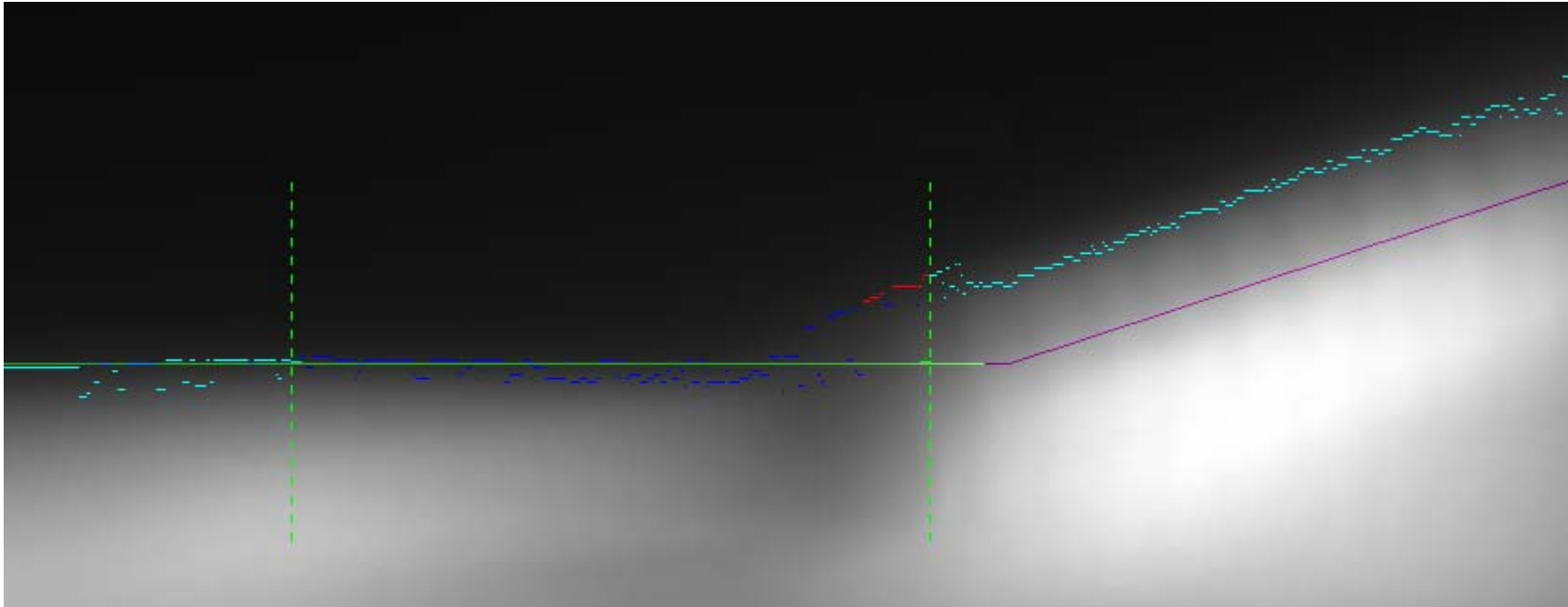
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

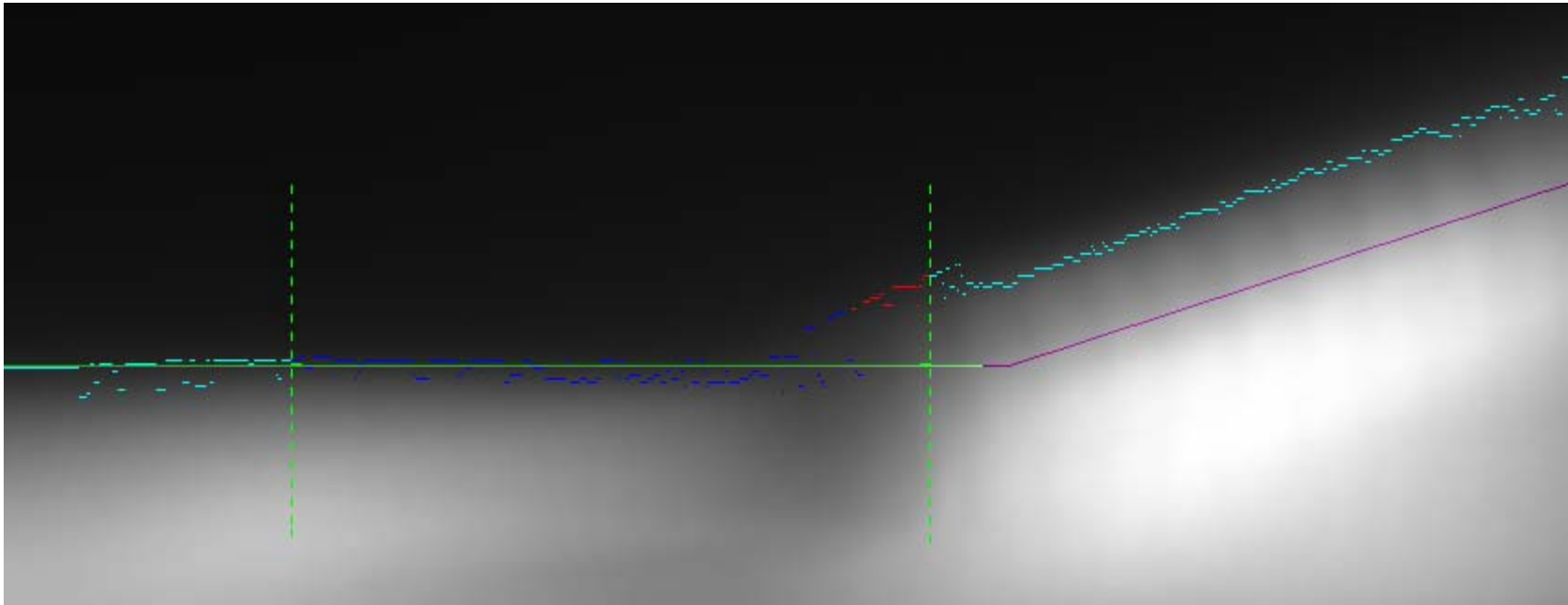
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

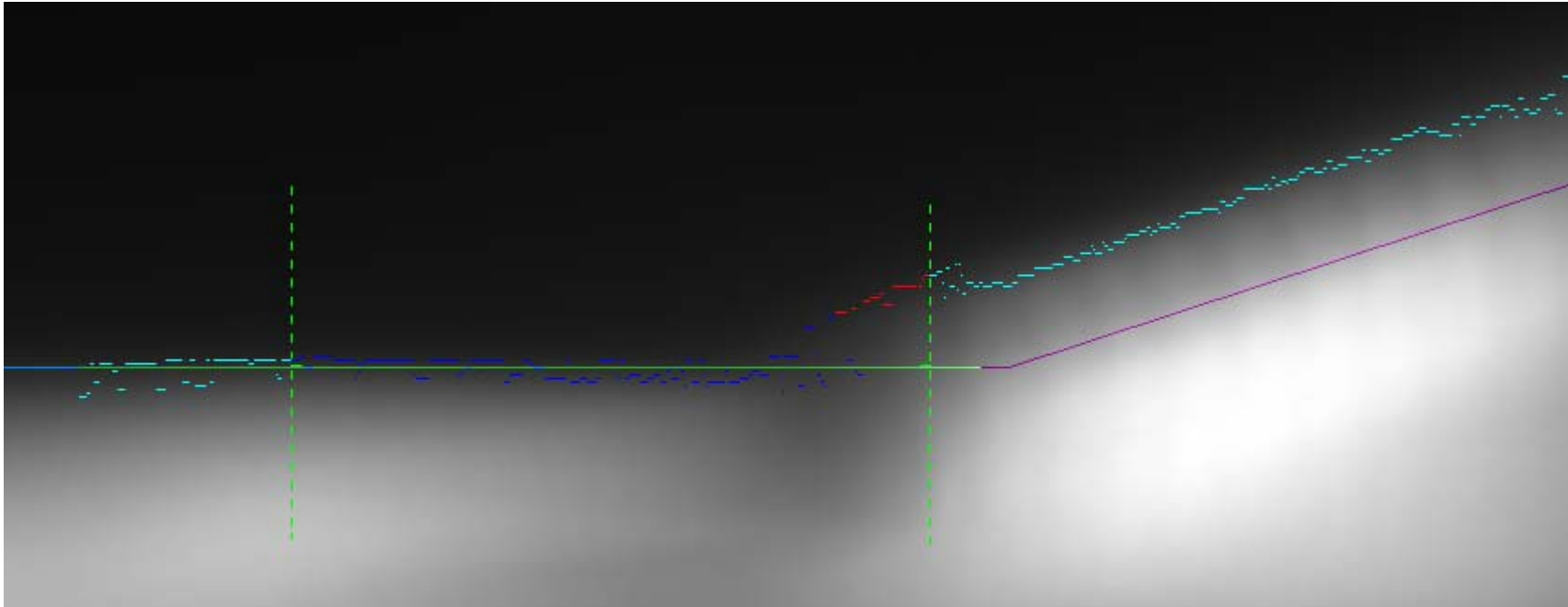
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

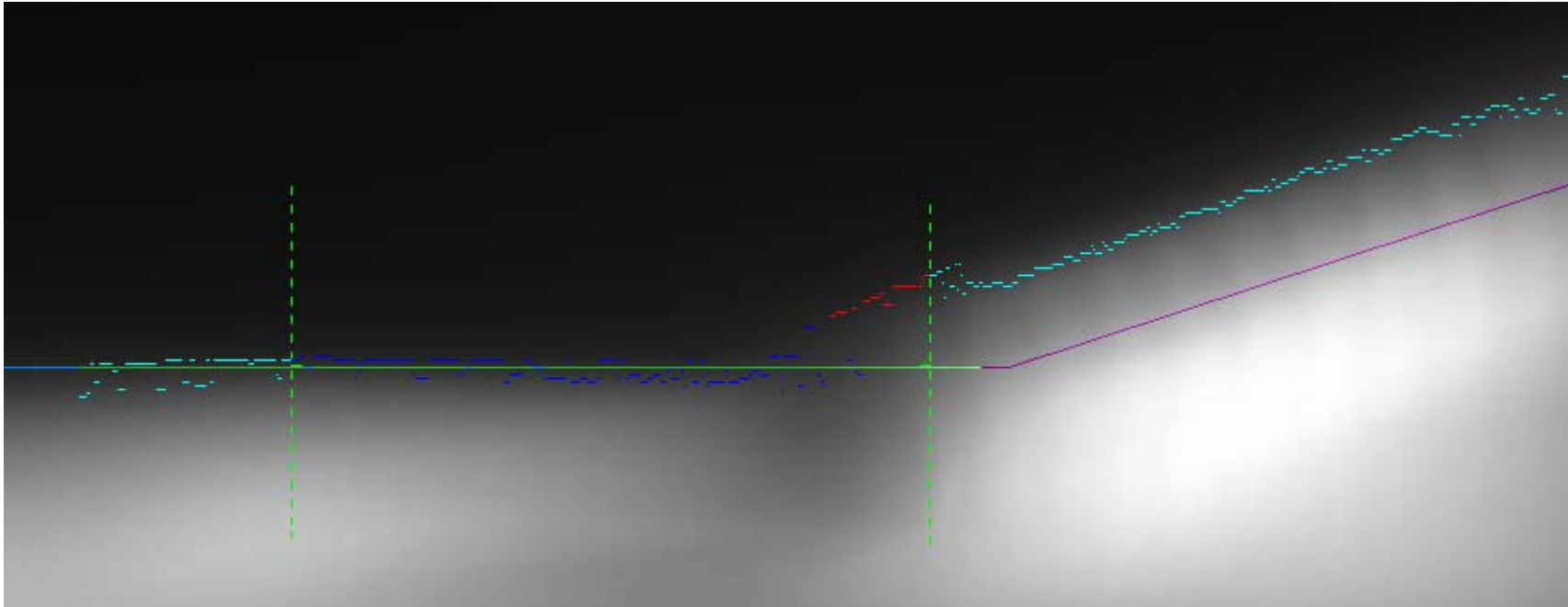
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

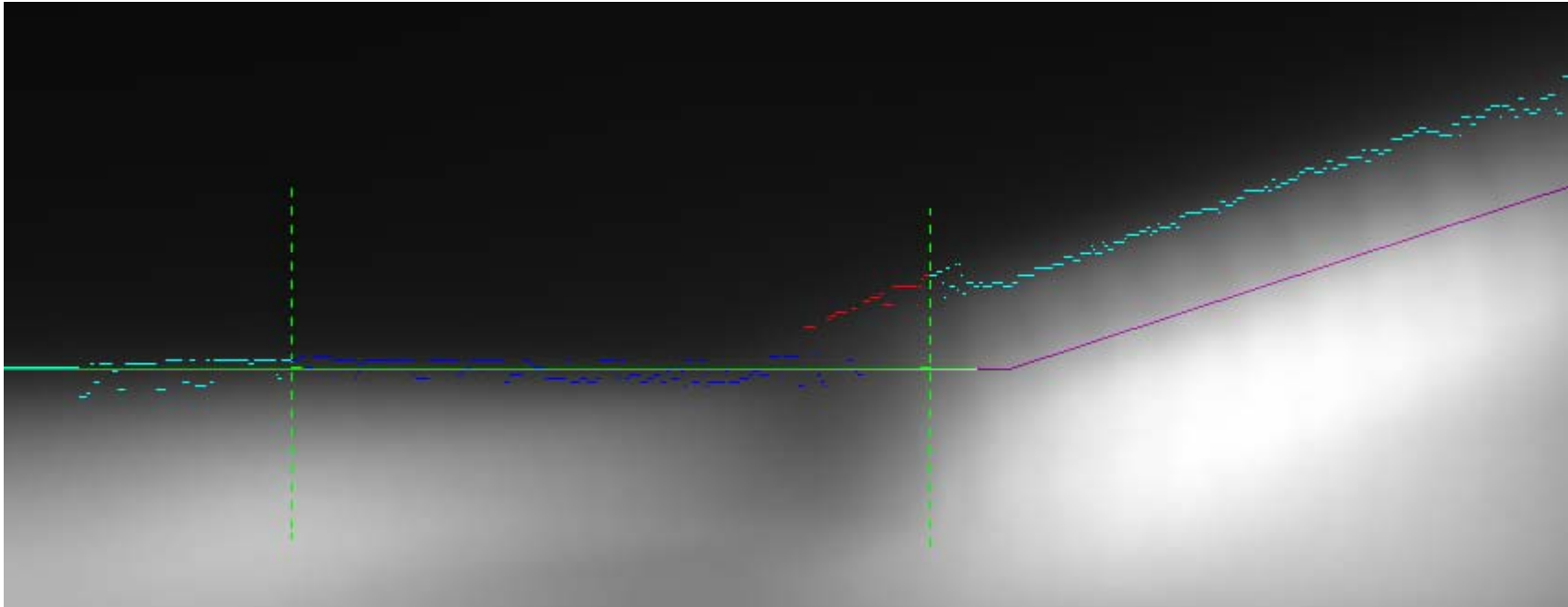
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

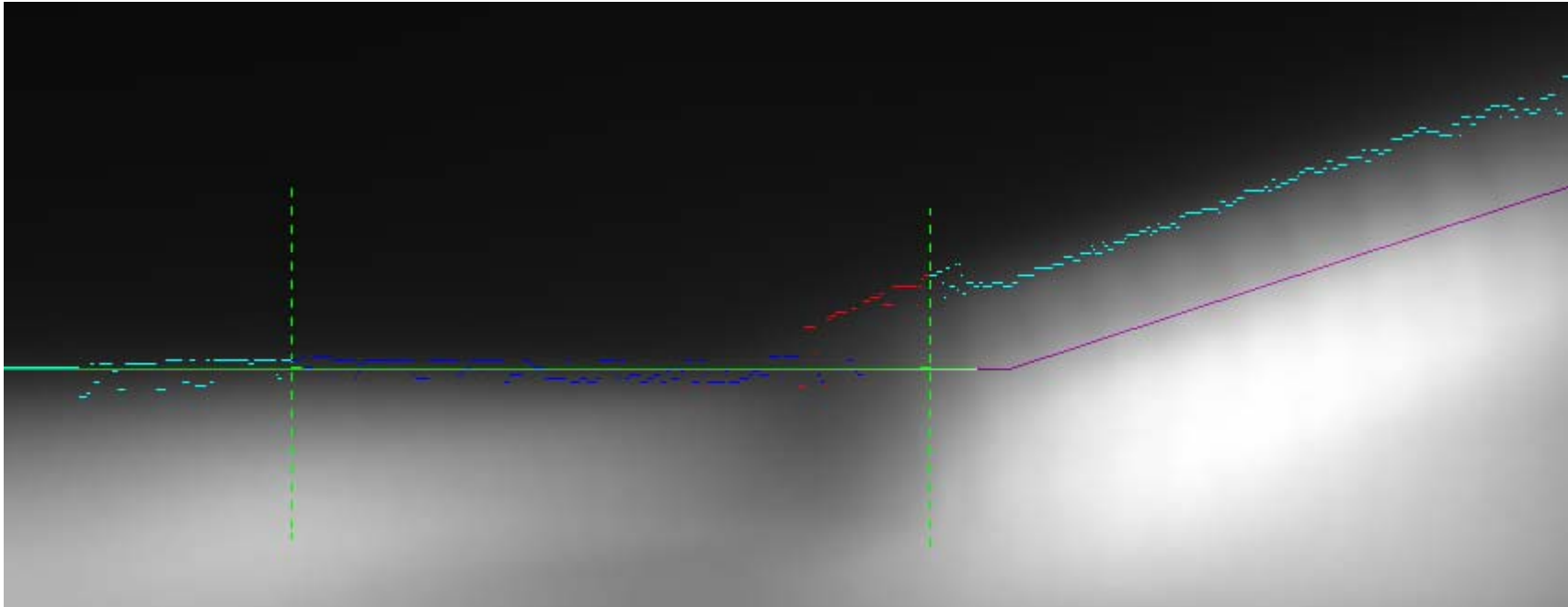
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

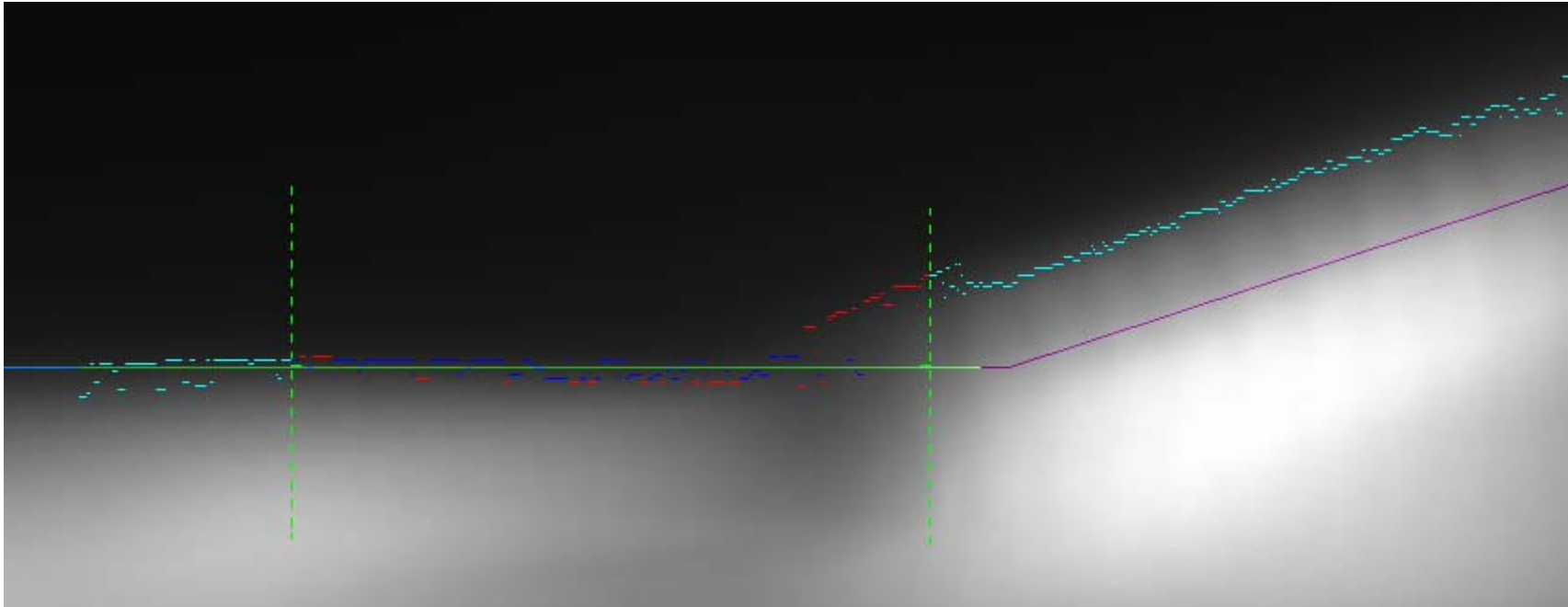
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

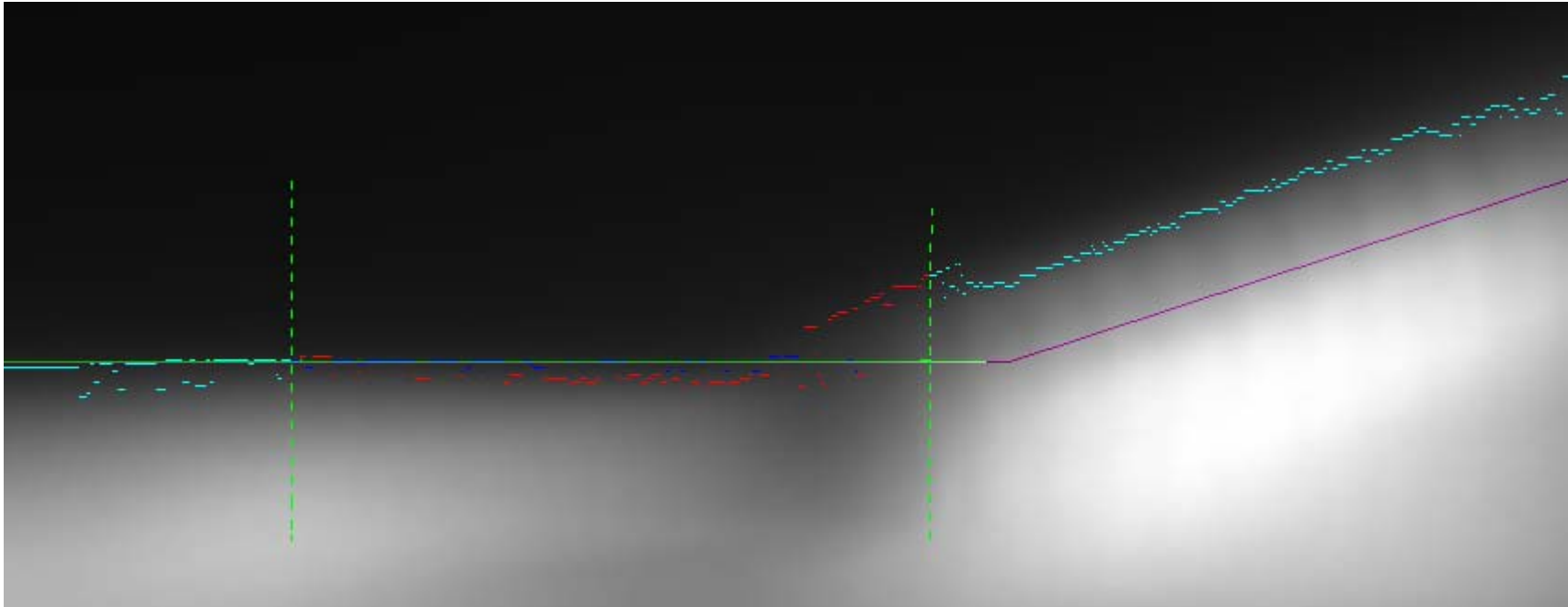
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

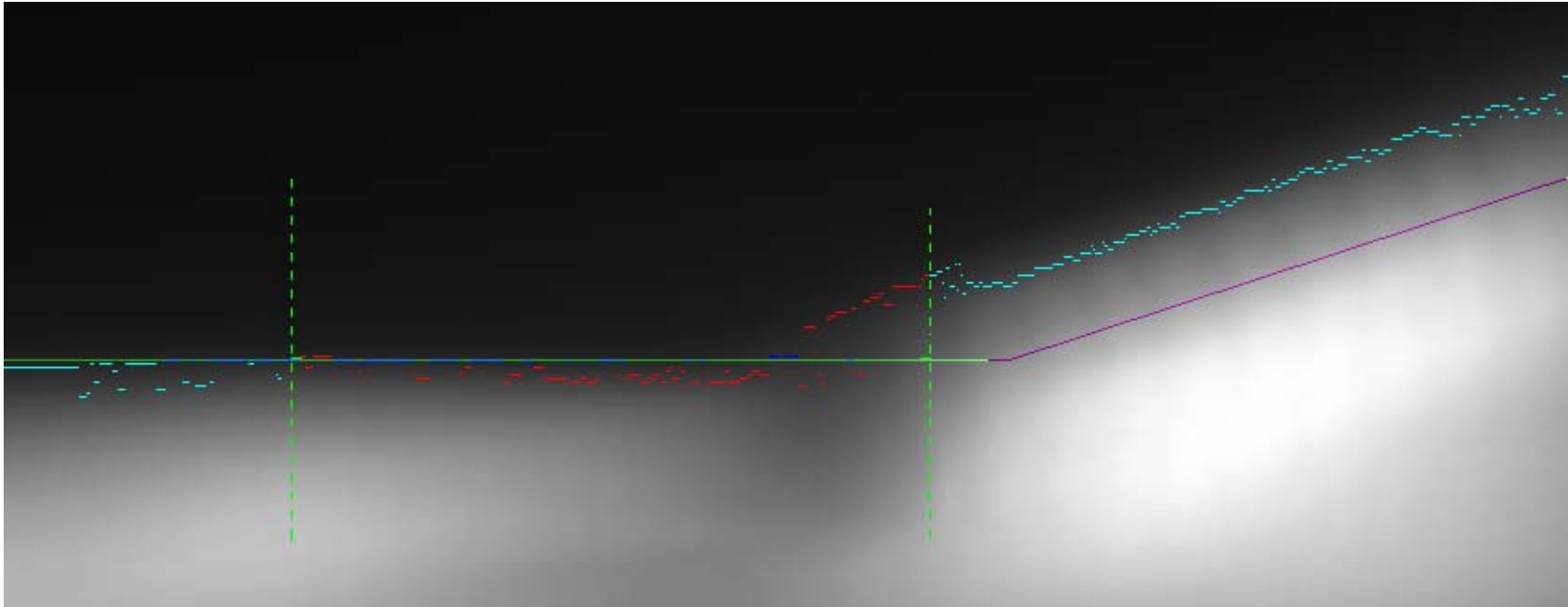
FOLLOWING STEP OF THE LOOP



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST VERTICAL ADJUSTMENT

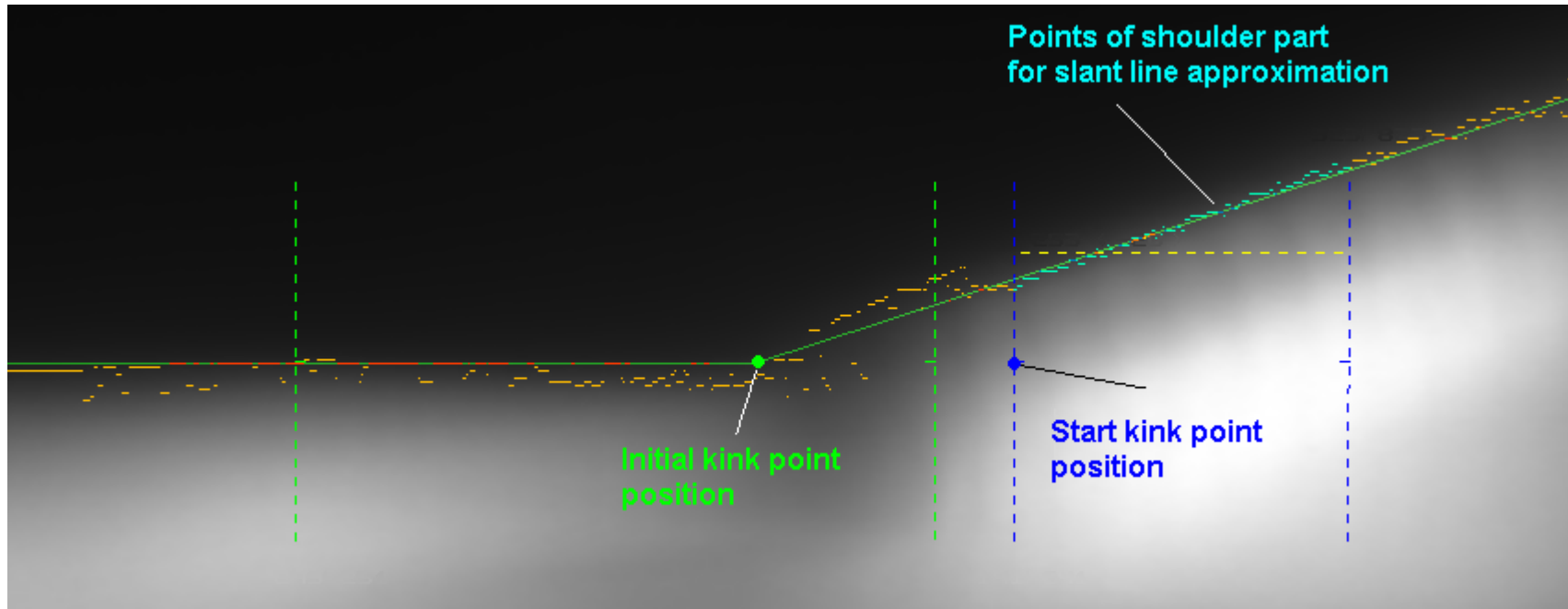
FINAL STEP OF THE LOOP



First approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

FIRST HORIZONTAL ADJUSTMENT

ORIGINAL STEP OF THE LOOP



Start „kink point” - horizontal place of visual pre-aiming

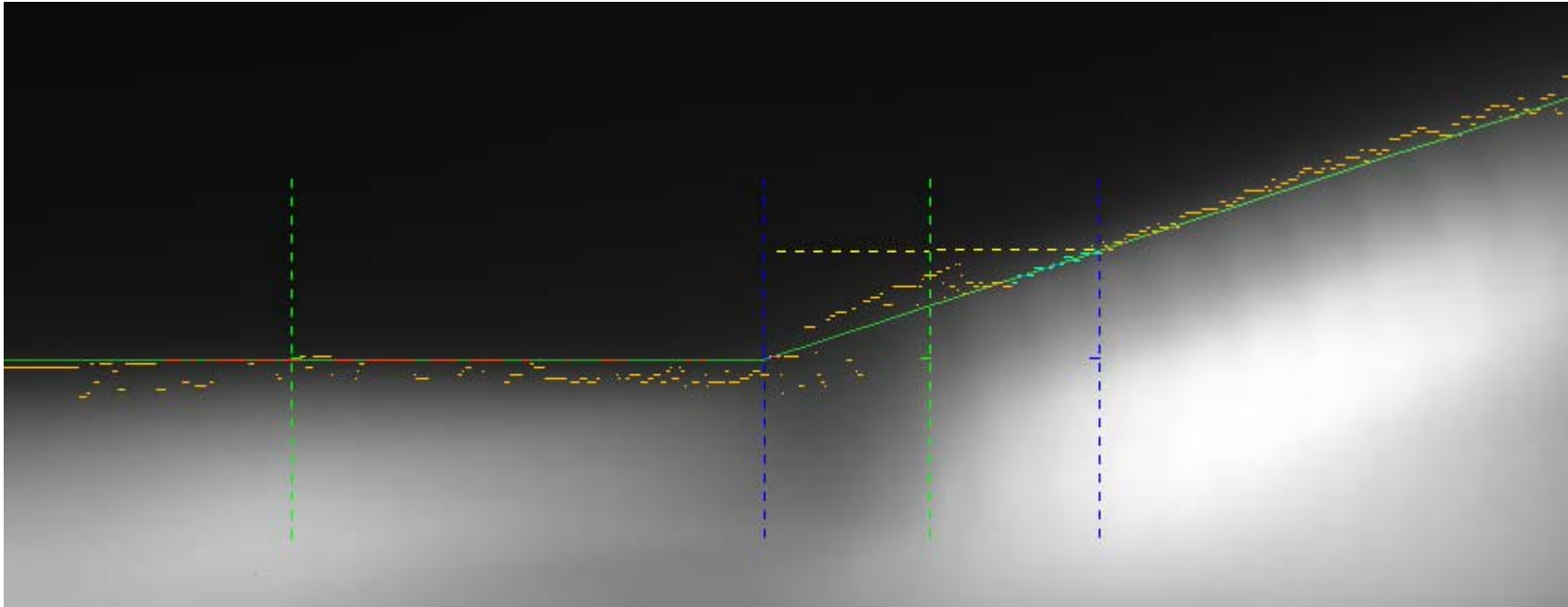
Initial „kink point” - result of first loop of procedure

Original approximation of „shoulder line part” and position of „kink point”, according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.2.1.

Remark: The position of initial “kink point” is very close to the position of final “kink point”, independently of visual pre-aiming precision.

FIRST HORIZONTAL ADJUSTMENT

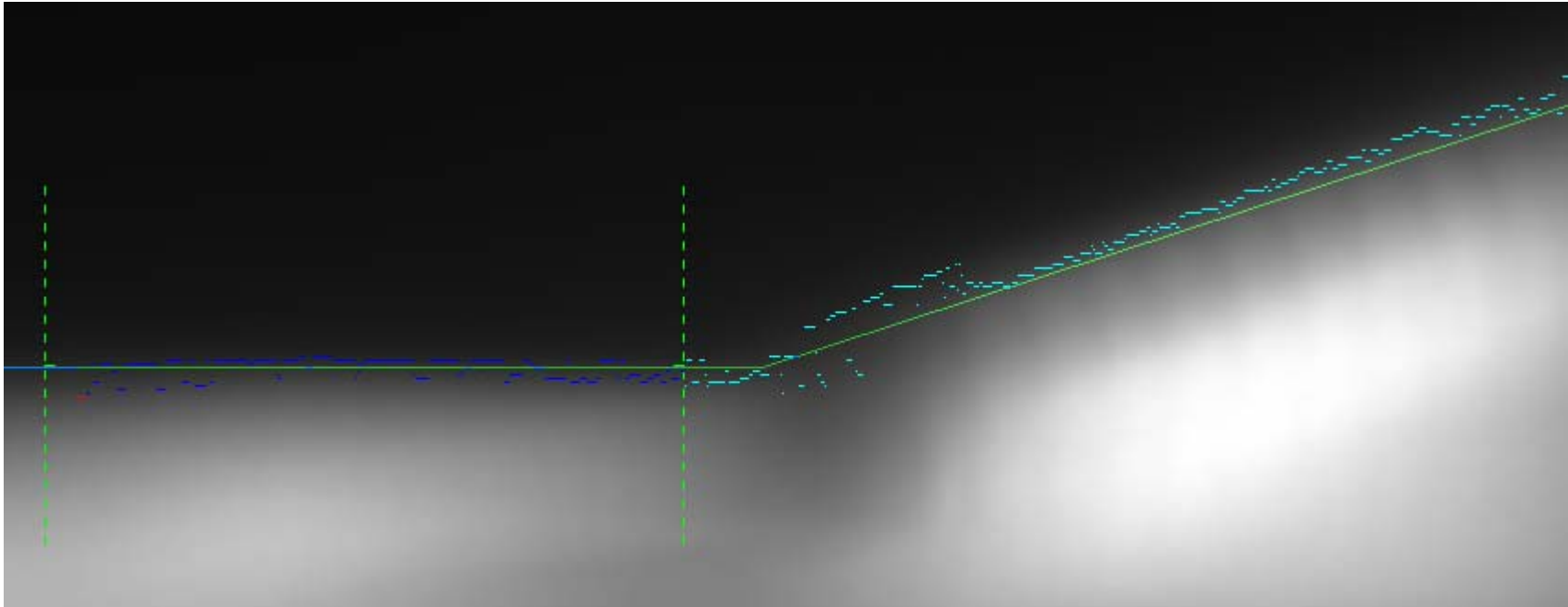
FINAL STEP OF THE LOOP



First approximation of “shoulder line part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1.

SECOND VERTICAL ADJUSTMENT

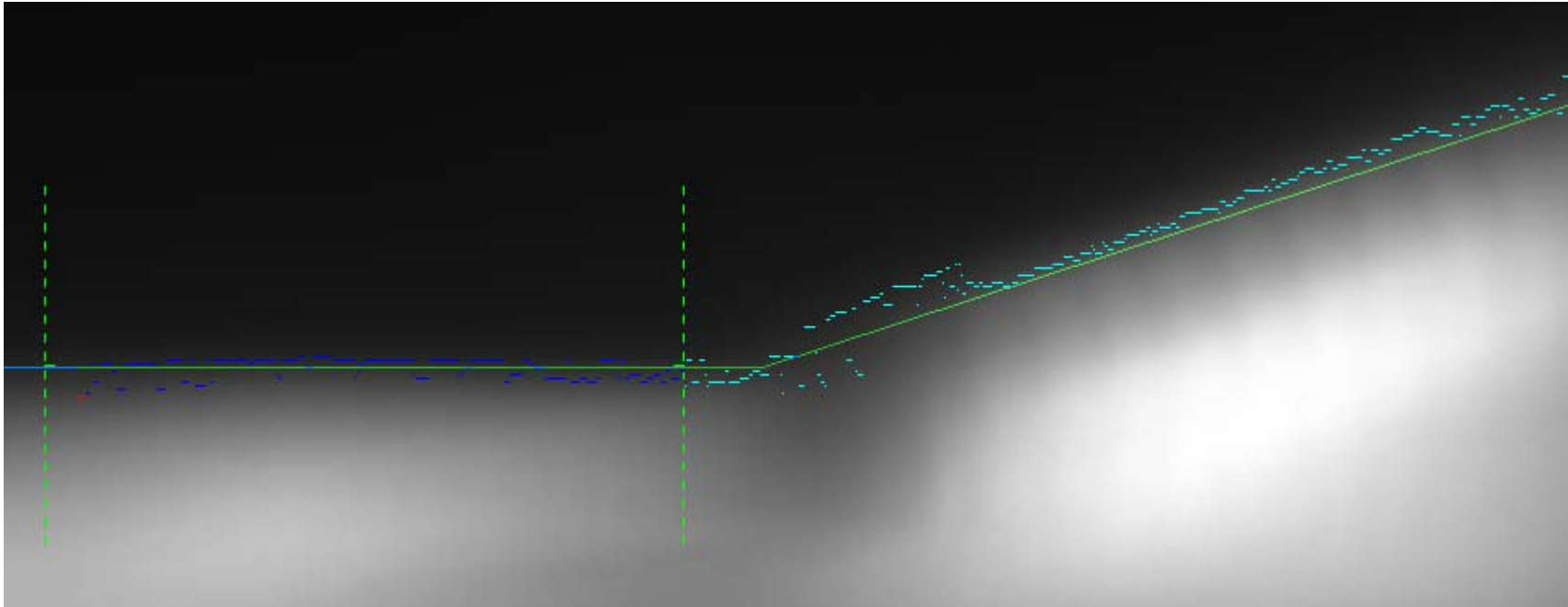
ORIGINAL STEP OF THE LOOP



Determining the original approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.1.

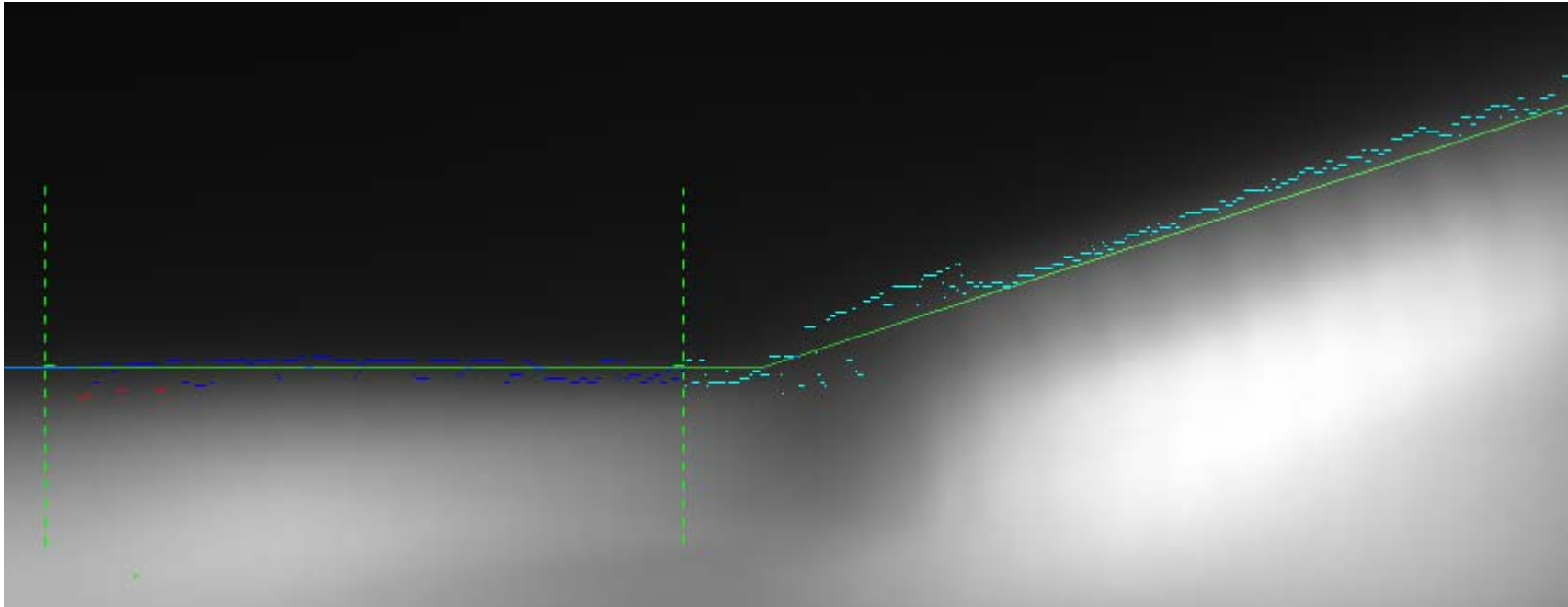
SECOND VERTICAL ADJUSTMENT

FOLLOWING STEP OF THE LOOP



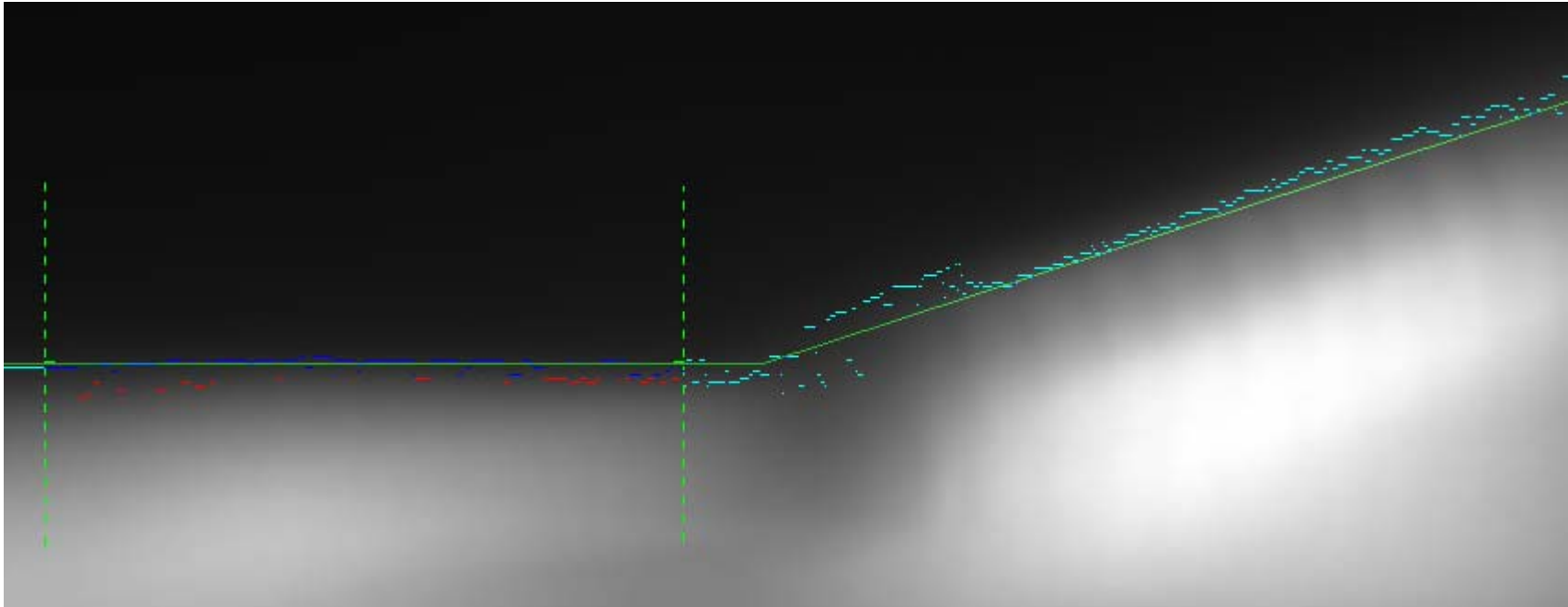
Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.2.

SECOND VERTICAL ADJUSTMENT *FOLLOWING STEP OF THE LOOP*



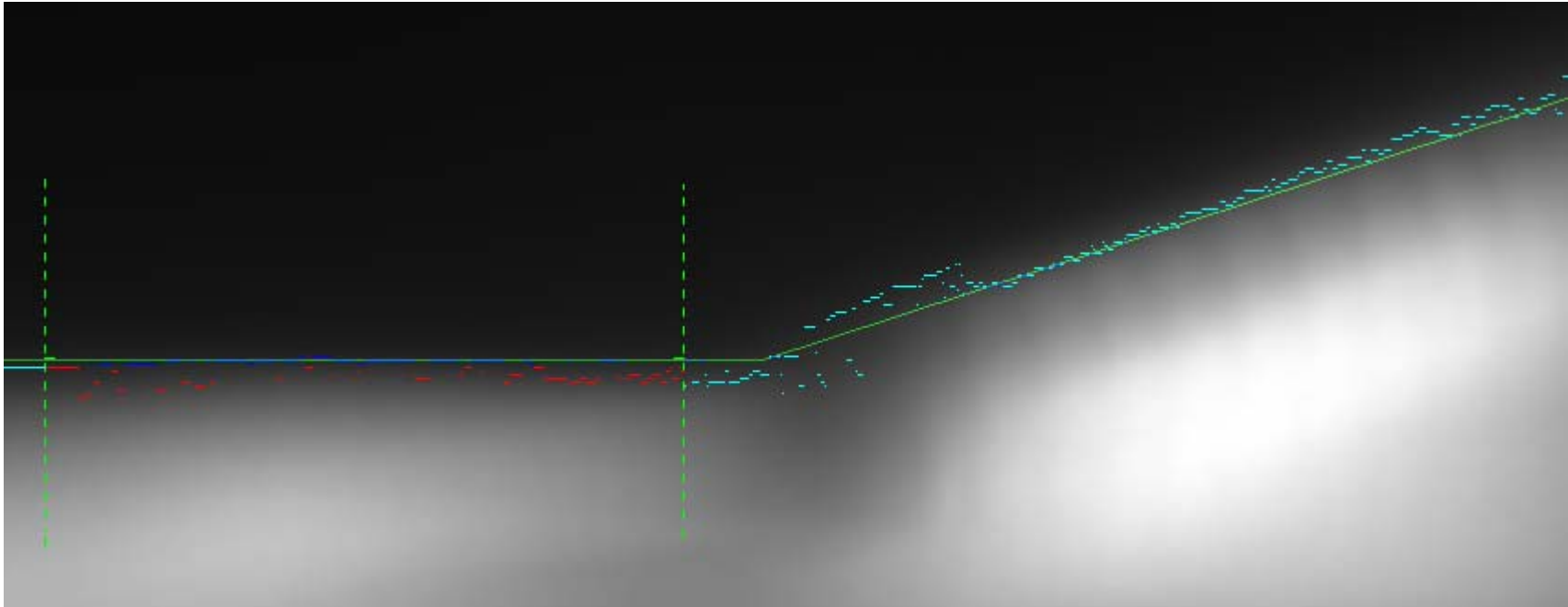
Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

SECOND VERTICAL ADJUSTMENT *FOLLOWING STEP OF THE LOOP*



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

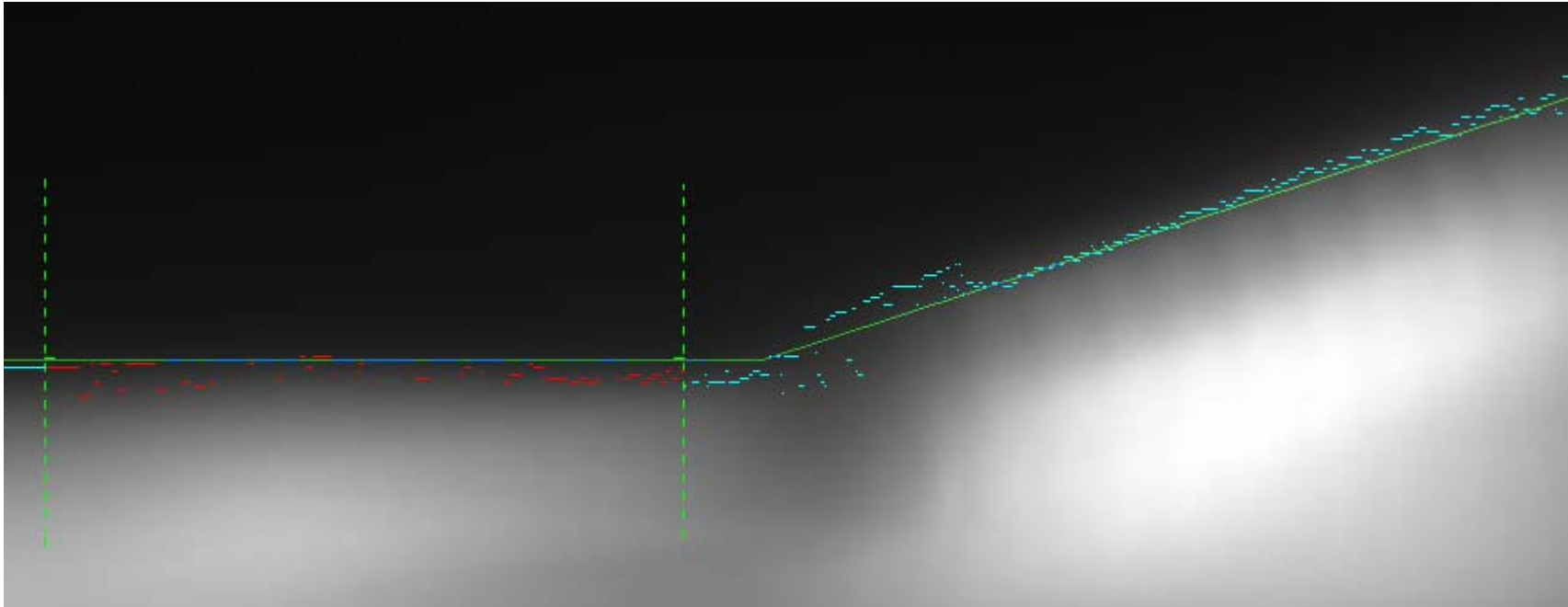
SECOND VERTICAL ADJUSTMENT *FOLLOWING STEP OF THE LOOP*



Determining the next approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

SECOND VERTICAL ADJUSTMENT

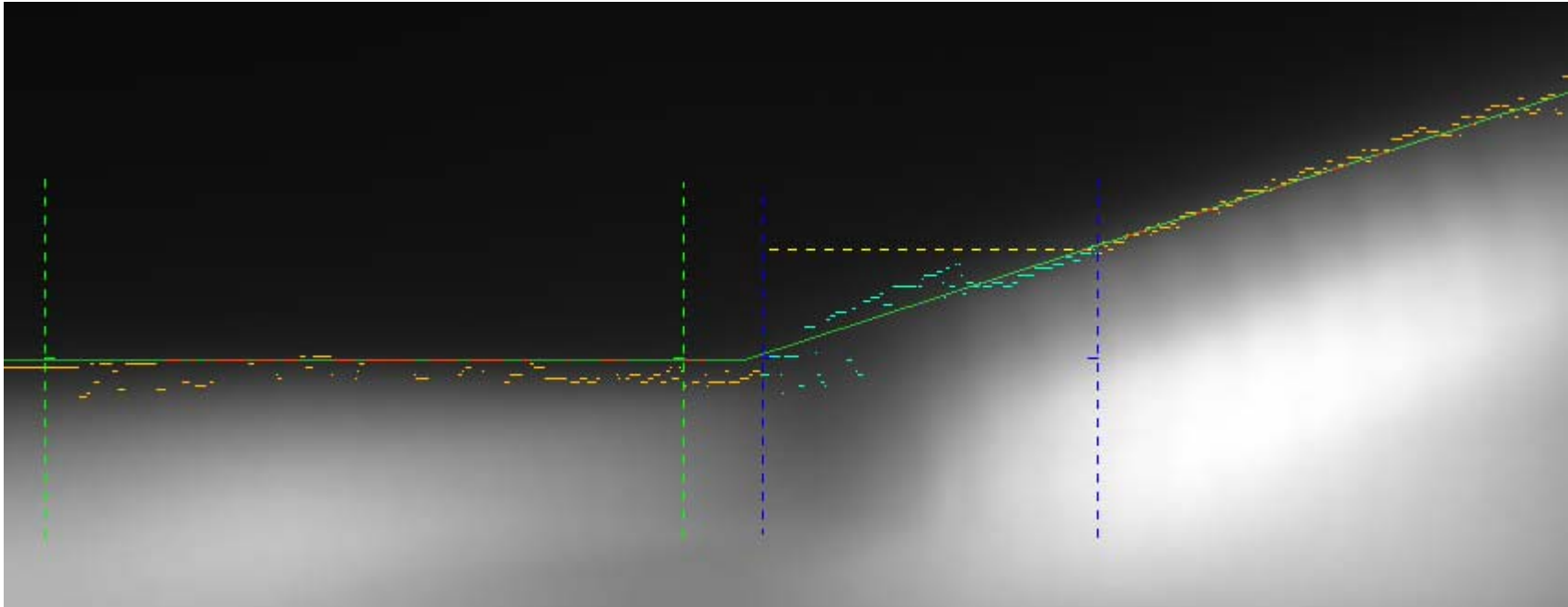
FINAL STEP OF THE LOOP



Second approximation of “horizontal part”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.1.3.

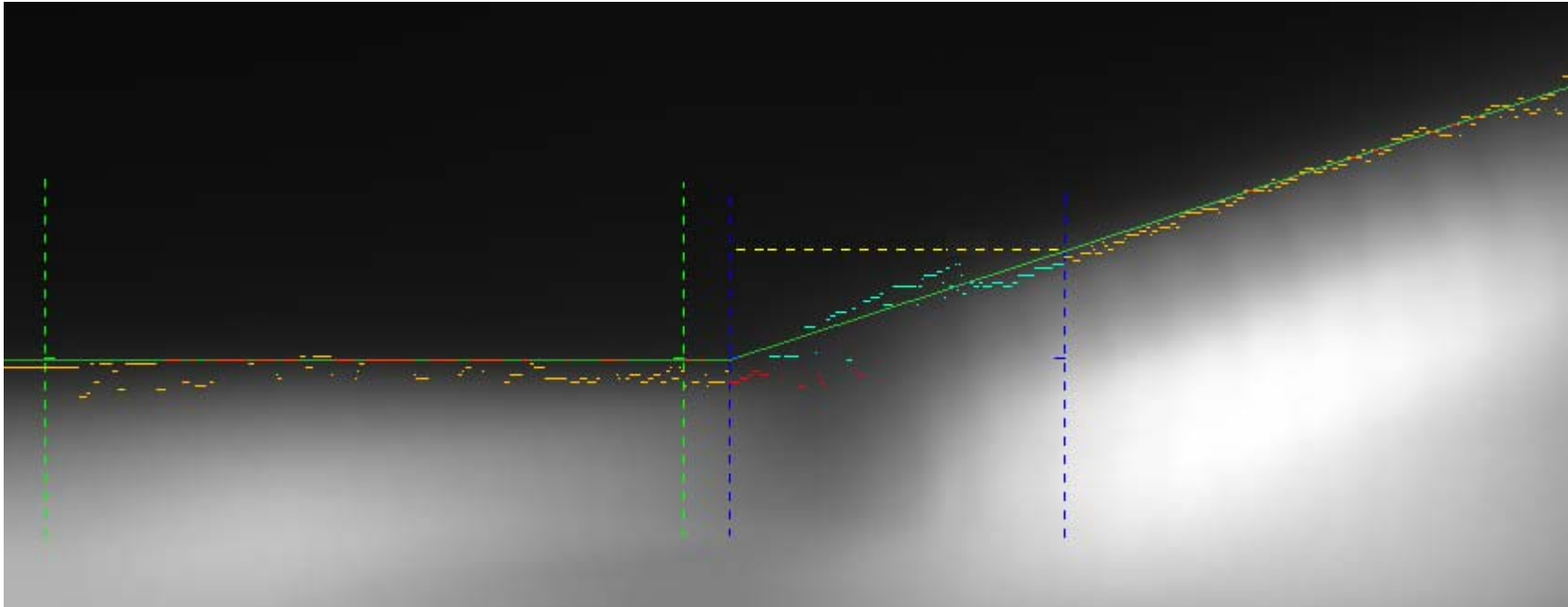
SECOND HORIZONTAL ADJUSTMENT

ORIGINAL STEP OF THE LOOP



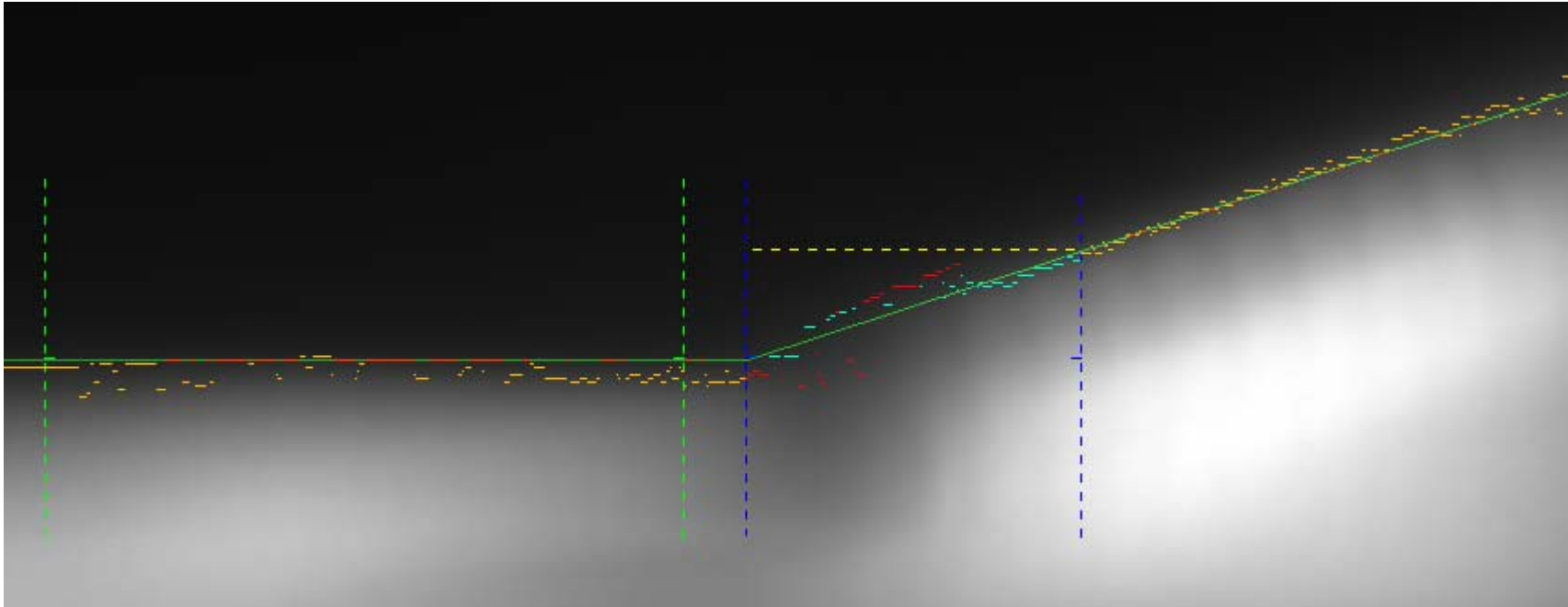
Original approximation of “shoulder line part” and position of “kink point”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.2.1.

SECOND HORIZONTAL ADJUSTMENT *FOLLOWING STEP OF THE LOOP*



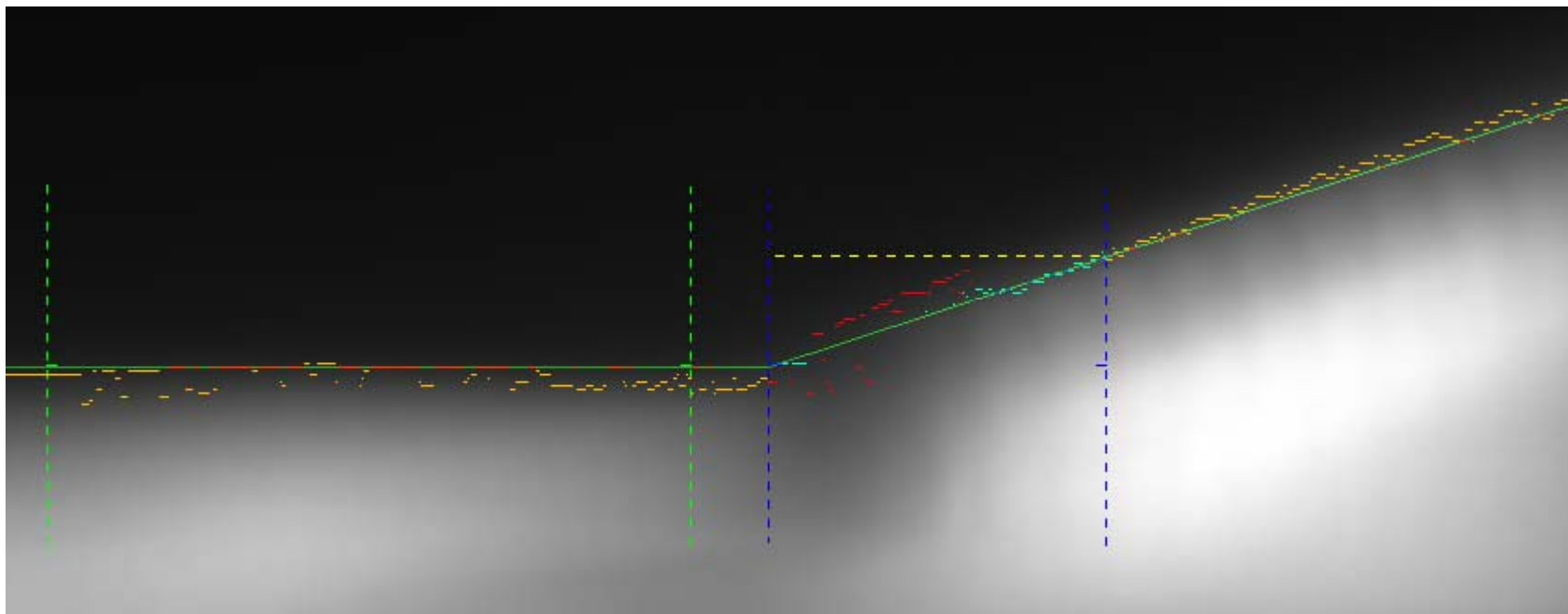
Determining the next approximation of “shoulder line part” and position of “kink point”, according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.2.2.

SECOND HORIZONTAL ADJUSTMENT *FOLLOWING STEP OF THE LOOP*



Determining the next approximation of “shoulder line part” and position of “kink point”, according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.2.3.

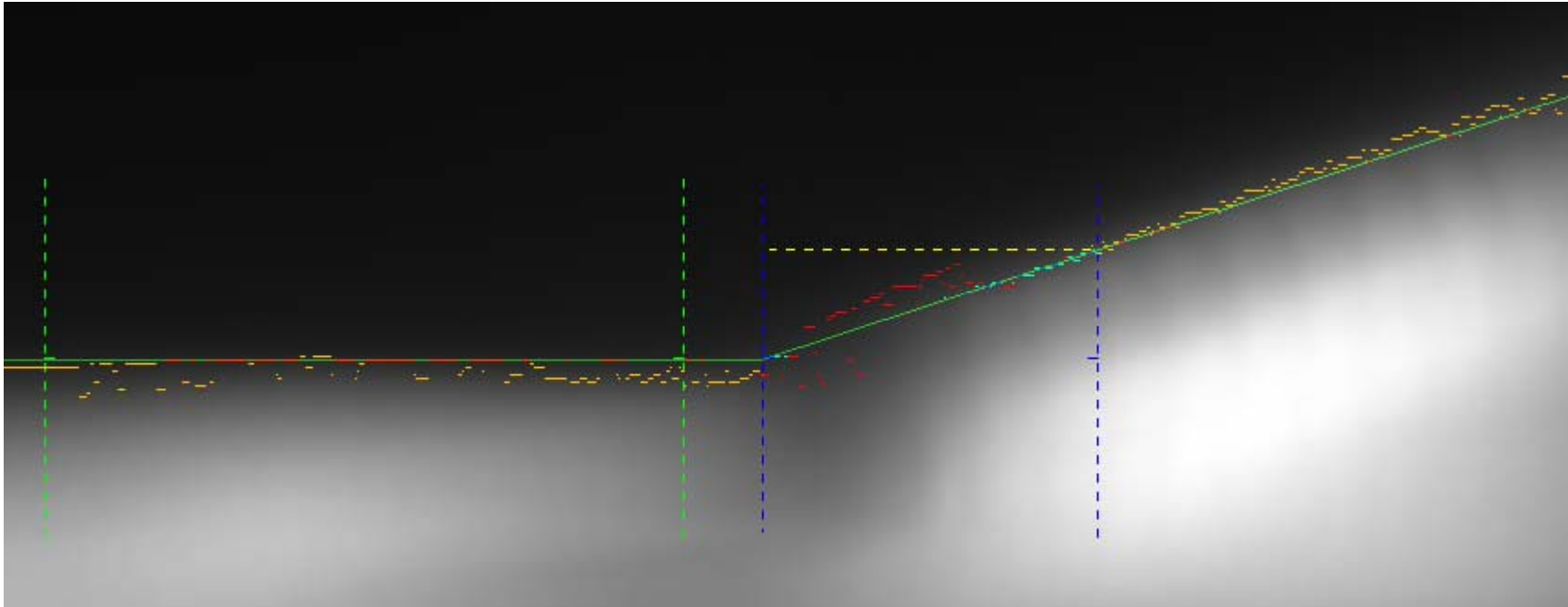
SECOND HORIZONTAL ADJUSTMENT *FOLLOWING STEP OF THE LOOP*



Determining the next approximation of “shoulder line part” and position of “kink point”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.2.3.

SECOND HORIZONTAL ADJUSTMENT

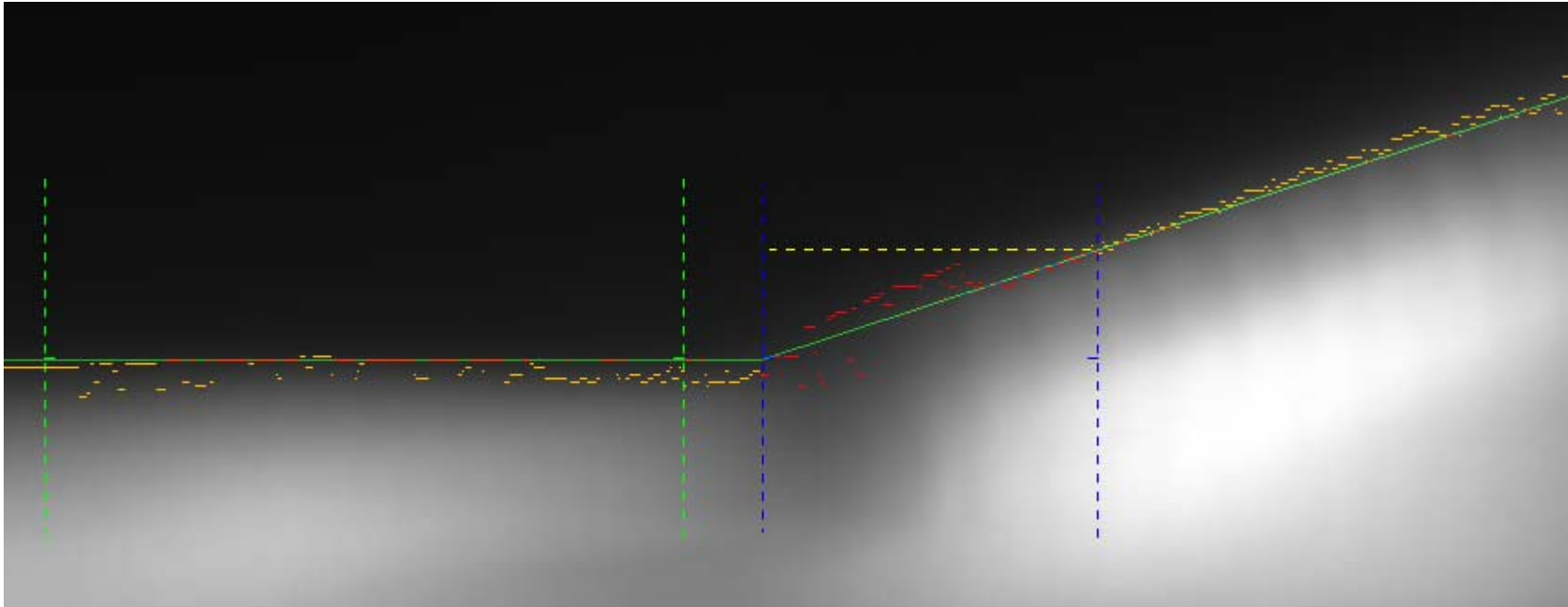
FINAL STEP OF THE LOOP



Second approximation of “shoulder line part” and position of “kink point”,
according to TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.2.3.

FINAL RESULT OF THE PROCEDURE

INSTRUMENTAL APPROXIMATION OF "CUT-OFF" LINE



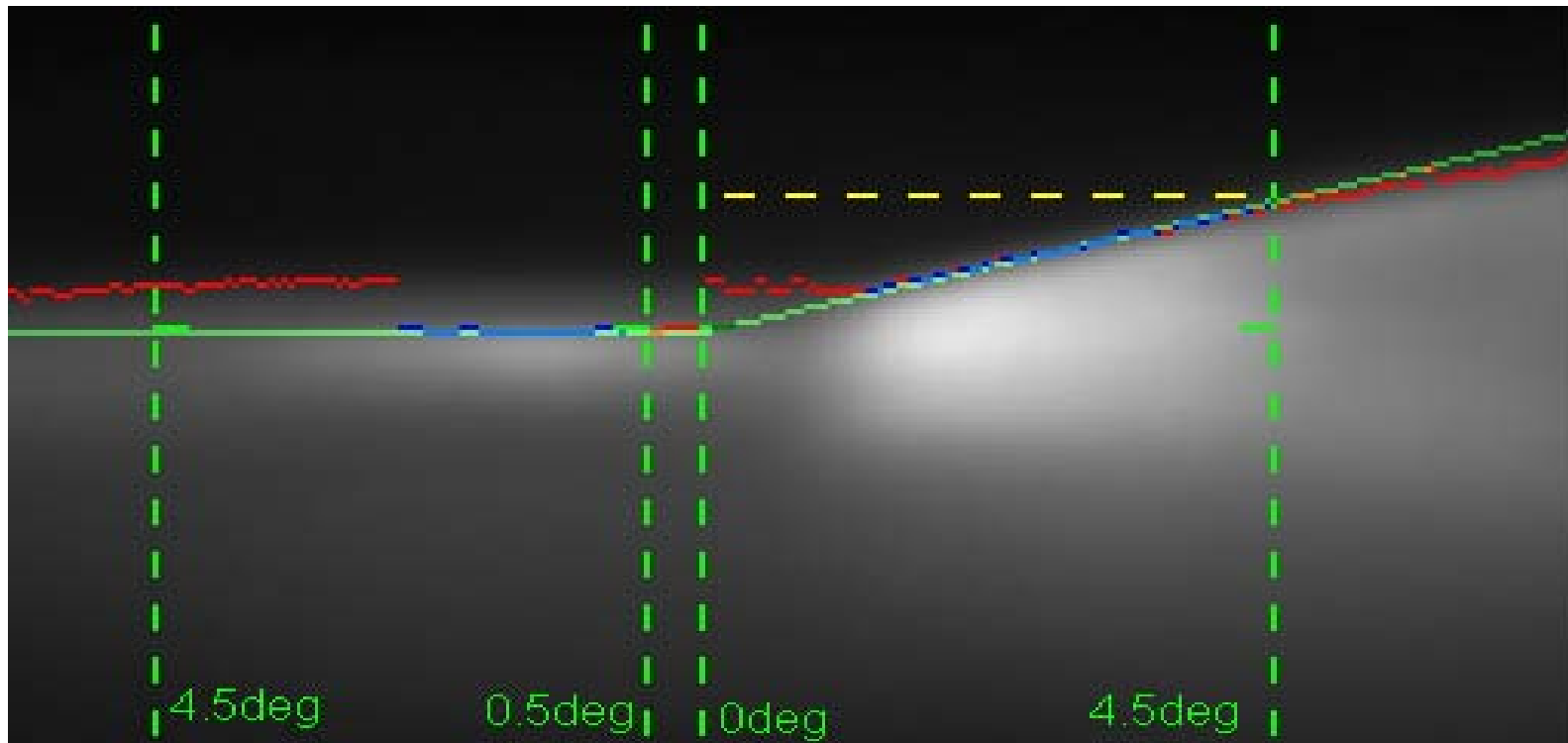
Result of instrumental adjustment procedure, according to
TRANS/WP.29/GRE/2002/44 Rev 1. Annex 9 p. 4.3.

Conclusion: Instrumental approximation of "cut-off" line is very
consistent with average visual position of "cut-off" line.

EXAMPLES OF REAL „CUT - OFF” LINES
OF STANDARD HEADLAMPS
EXPLAINING AMBIGUITIES OF DEFINITIONS
PROPOSED IN AFS DRAFT XXX

Remark: Please, pay attention to multiplied “kink points”, different kinds of
_____ “kink points”, linear approximations of “shoulder line parts” and
_____ distances between “kink points” and maximums of illumination.

DISCONTINUITY ON „HORIZONTAL PART”



Green line - instrumental approximation of „cut-off” line

Red points - points described in Draft XXX Annex 9 which form real „cut-off” line

Blue points - points of real cut-off line agreeing with approximation

