openETCS “Determine Train Location” Procedure

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# openETCS “Determine Train Location” Procedure

## references

UNISIG Subset\_026 version\_3.3.0

Chapter 3.6 : Location Principles, Train Position and Train Orientation

## object

This document specifies the mathematical relationships needed for train position calculation.

This document version reflects only those equations that have been used within the CalculateTrainPosition SCADE model implementation at <https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/TrainPosition/CalculateTrainPosition>.

# Basic Inaccuracy Calculations

## Addition of independent Tolerance Values

is a triple of a nominal value with a minus tolerance (negative) and a plus tolerance (positive) so that

.

The addition of 2 such values leads to

.

For the addition of more values in general:

This equation in a different notation

... which means that the tolerances of the sum equals the sum of the tolerances.

This applies only, if each of the values has its own tolerances independent from each other.

## Subtraction of Tolerance Values

The substraction of 2 tolerance affected values leads to

The minimum and maximum tolerance limits are generated by the suitable combination of min/max of values 1 and 2:

## Distances between linked Elements (BaliseGroups, ...)

The rules of chapter 2.1 and 2.2 refer to distances between elements along the track in general.

But for distances between linked elements, there is an important difference: Linked elements like balises are – as specified in Subset 026-3.6 – thought to be positioned on an absolutely correct nominal position with known min/max accuracy around the nominal position.

Therefore, the tolerances of 2 and more linking distances between balises must not be summed up as calculated in chapter 2.1. Instead, only the positioning inaccuracies of the first and the last balise group in a chain of linking distances is relevant for distance calculation:

# Odometry Model

The odometry subsystem is assumed to provide its own inaccuracies with the nominal, minimum and maximum travelled distance since system start as inputs to the OBU software:

* = nominal value
* = minimum value
* = maximum value

At system start all values are 0.

= = = 0

The distance between two odometry locations is presumed to

The original outputs of the odometry must never be manipulated by the OBU software.

# Determination of the Train Location

## The OBU Coordinate System

As a measure for train location, the OBU makes up its own the one-dimensional coordinate system. It is private and only known by the OBU.

The origin of the OBU coordinate system can be chosen arbitrarily; to set it at system start up is a suitable choice.

The orientation of the coordinate system equals to the actual train orientation.

The train starts at location 0 at system start up.

The OBU coordinate system is preserved as long as the train is in operation; a reset of the coordinate system is permitted only when the OBU is restarted or all location and position information can be deleted.

## Location of Track Elements

All track elements – linked as well as unlinked – are mapped to their appropriate location on the OBU coordinate system by calculating distances as specified in chap. 2 and 3.

## Train Position = Location of the Train

The actual position of the train is mapped to the OBU coordinate system by calculating distances as specified in chap. 2 and 3.