Evaluation of GNSS for the realization of the autonomous car

2015 Cross-ministerial Strategic Innovation Promotion Program ～Autonomous Driving WG～

This survey was conducted for the purpose of assessing the availability of satellite positioning technology for autonomous cruising.
Because preparation and updates of satellite positioning systems are promoted in various countries, it is considered that the improvement of satellite positioning accuracy by multi-GNSS is available for autonomous cruising.
In this research work, we conducted experiments on interurban expressway and in urban area in order to evaluate positioning rates and accuracy of each positioning method and satellite system. We also considered about effect of multipath and signal-blocking.

	Method
M1	Single Frequency
M2	L1-SAIF
M3	DGPS
M4	Dual Frequency
M5	RTK
M6	CMAS
M7	NADOCA-PPP

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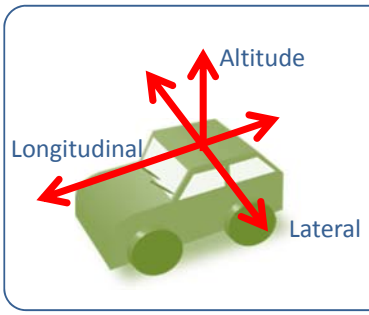
	System
S1	GPS
S2	GPS+QZSS
S3	GPS+QZSS+GLO
S4	GPS+QZSS+GLO+BDS +GAL

GLO: GLONASS
BDS: BeiDou
GAL: Galileo

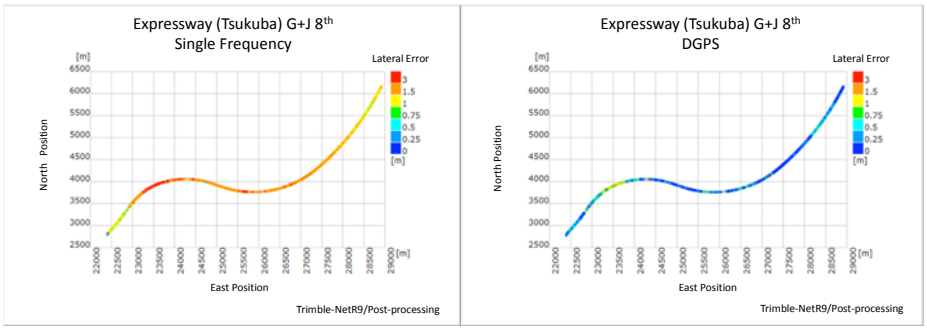
Combination of data analysis



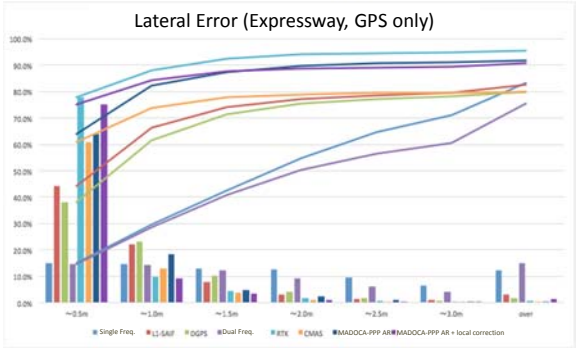
- Time(UTC)
- Reference coordinates(MMS)
- Coordinates
- Speed(Estimation)
- Number of satellites in use
- HDOP

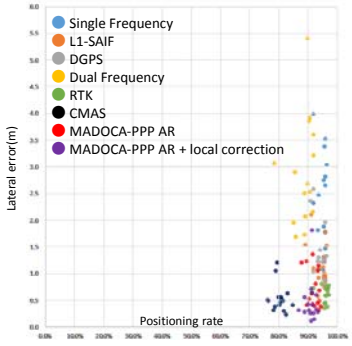
Target of evaluation

Image of experiments



Heat map of lateral error on interurban expressway
(Left：Conventional method/Right：using QZSS L1S)





Positioning rate – Lateral error plot of each method

Method	Positioning rate	RMS[m]
Single Frequency	95.01%	2.3202
L1-SAIF	94.53%	1.1618
DGPS	94.48%	1.3290
Dual Frequency	88.01%	3.1317
RTK	95.62%	0.6379
CMAS	80.27%	0.5282
MADOCA-PPP AR	92.12%	0.7149
MADOCA-PPP AR + local correction	91.01%	0.4617

※CMAS is Fix only

- By using augmentation signals（L1-SAIF/DGPS) for conventional single frequency method, lane recognition(about 1.5m accuracy) can be realized.
- It is necessary to use carrier phase positioning system to achieve accuracy less than 1m. In this case, positioning rates will decrease a little.

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