SIP-adus Workshop 2017
on Connected and Automated Driving Systems

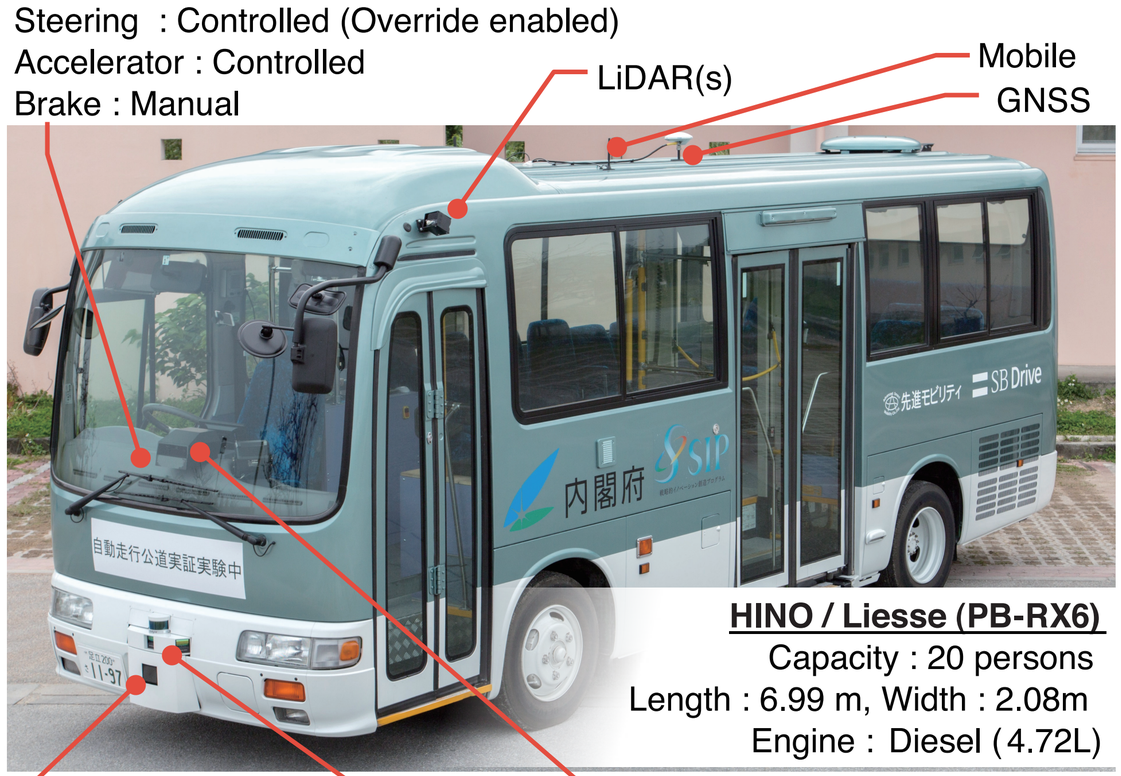
Field Operational Tests

Self-Driving Bus Feasibility experiment in Public Road in Okinawa pref.

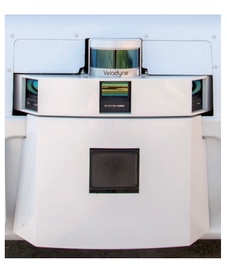
■ Experiment Conditions and Equipment

		Nanjo City	Ishigaki City
Experiment (in 2017)	Period	Mar. 20 - Apr.2	Jun. 25 – Jul. 7
	Distance (One way, Total)	1.2 km, 84 km	16 km, 1650 km
	Max. velocity	35 km/h	40 km/h
	Road environment	•Public •Low-traffic •Bus stop (Straight)	• Public • High-traffic • Intersection • Bus stop (bay-type)
	Total passengers	160 (approx.)	370 (approx.)
Steering control	Lane keeping (path referring)	○	○ (with edge stone detection)
	Obstacle avoidance	○	○
	Bus stop arrival	○ (LiDAR)	○ (RTK-GPS)
Velocity control	CC	○	○
	ACC	-	○
	Traffic light consideration	-	○

Steering : Controlled (Override enabled)
Accelerator : Controlled
Brake : Manual



HINO / Liesse (PB-RX6)
Capacity : 20 persons
Length : 6.99 m, Width : 2.08m
Engine : Diesel (4.72L)


Front sensors

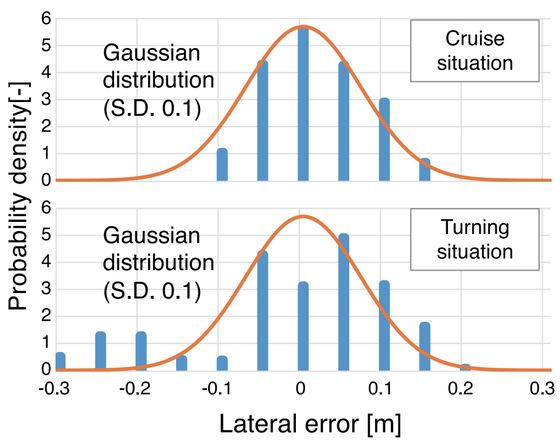

Rear side sensors

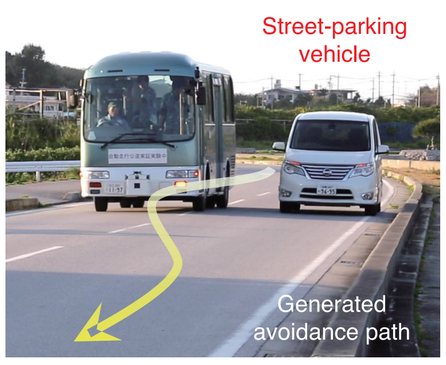

Steering (controlled motor)

HMI (display for driver)

■ Lane keeping and Obstacle Avoidance

- The accuracy of lane keeping control was evaluated as lateral error (against reference path). The lateral error was within ±0.1m(approx.).
- When sensors detect obstacle in own route, the bus can avoid it by control.



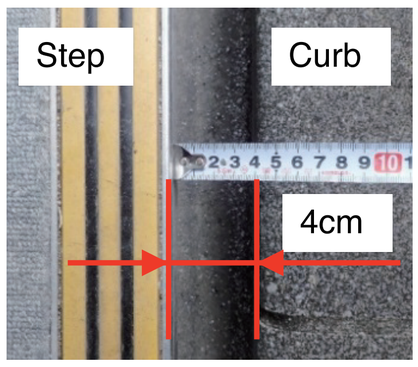


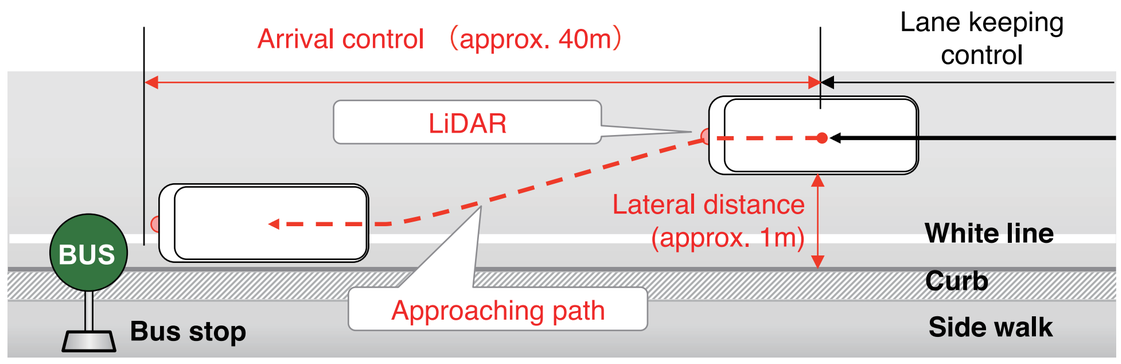
Example of avoidance control

■ Accurate Arrival to Bus stop

- The accuracy of bus stop approach and arrival were verified.
- The target distance is 4cm.

Result (Final lateral distance) :
- ✓ average 4.0cm (S.D.±1.47)
- ✓ maximum 7.2cm(avg. + 3.2)
- ✓ minimum 1.6cm(avg. -2.4)





■ Evaluation of Steering Override

- Steering override ratio was evaluated in 4 services that extracted randomly from 108 services.
- The representative override situation were follows.
  - ✓ GNSS signal intensity decreases (unstable steering).
  - ✓ To avoid street-parking vehicle in complex situation.

Steering override ratio* (Total)	Steering over ride ratio* (by using sensor)	
	RTK-GPS	LiDAR(curb detection)
7.4 %	5.6 %	23.1 %

* Ratio in mileage

■ Social Acceptability Survey

- Questionnaire survey about self-driving bus were carried out to trial passenger.
- Approximately 75% people answer that the running by self-driving is “Secure” or “little secure” .