

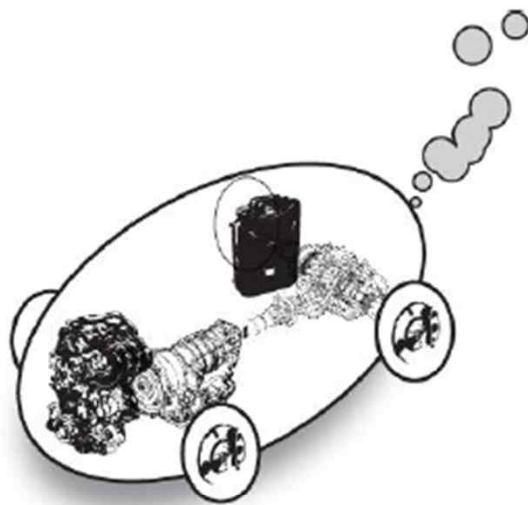


In-Wheel Motor EV 개발 사례 (II)

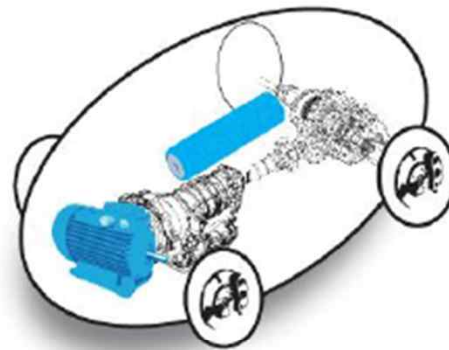
2016. 9. 28

(주)스페이스센싱
SpaceSensing Co.,Ltd

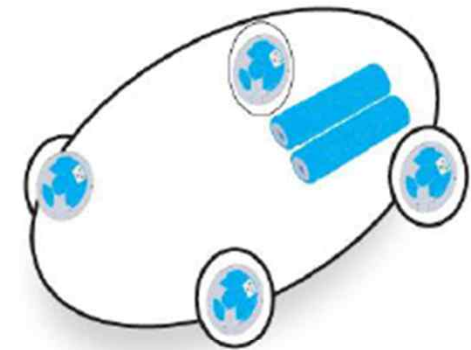
Disruptive Technology: electric in-wheel motors



past



present

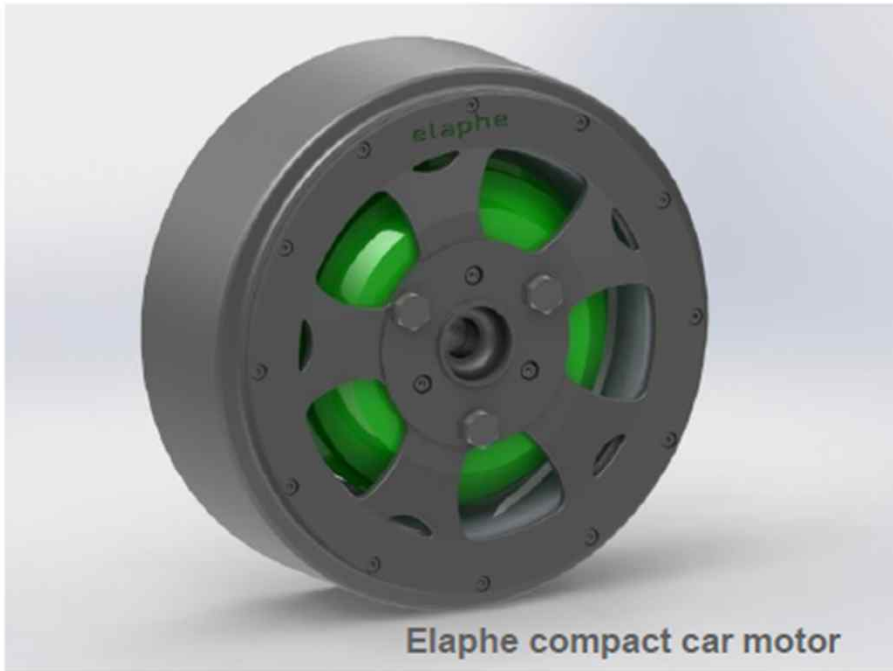


future

Solving the pain

- Increasing the range
- Reducing the weight and number of components
- Enabling attractive and driver friendly design
- Reducing the price of vehicle design, its production, operation and maintenance

Elaphe in-wheel technology



Elaphe compact car motor



Elaphe compact car motor

Competitive advantages

- The highest specific torque on the market
- Over 93% energy efficiency
- High power and low losses
- Lower weight and compact design

„Off the shelf“ motors – Elaphe M-Type



Elaphe M-700, compact car motor



M-700 ready for shipping

Competitive advantages

- 700 Nm peak, 400 Nm continuous
- Only 24 kg of added weight
- Possibility of integrated drum brake
- Fits inside 15" or 16" rim
- Dedicated low cost, high power 100 V inverter or 400 V system

„Off the shelf“ motors – Elaphe M-Type



Elaphe M-1100 heavy duty motor



Shipment of M-1100 motors assembled with rims and tires

Competitive advantages

- 1100 Nm peak, 700 Nm continuous
- Robust design
- Heavy duty attachment points and high load automotive bearing

PCU – „Propulsion control unit“

Condition monitoring
& logging

Torque distribution



Human-machine
interface

Some showcase Elaphe in-wheel powered cars

Two-wheelers,
2005-2009



Important for testing.
In use for many
years...

Architecture

- Fully electric
- Different rotor and rim concepts

Key facts

- 140 Nm of torque
- Only 9kg of mass with rim included

Some showcase Elaphe in-wheel powered cars

Chebela, 2011



Cooperation with
Oprema Ravne
Company

Architecture

- Fully electric
- Two in-wheel motors in rear wheels

Key facts

- 2×300 Nm of torque
- For bottom up developed vehicle

Some showcase Elaphe in-wheel powered cars

Smart, 2012-2014



Architecture

- Fully electric
- Two M-Type in-wheel motors in rear wheels

Key facts

- 2×700 Nm of torque
- Fits around existing parts
- Elaphe demonstration and testing vehicle

Some showcase Elaphe in-wheel powered cars

Directus, 2014



The project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement number 313980

Architecture

- Diesel-Electric Hybrid
- Front ICE drive and rear direct EV drive

Key facts

- 2×1000 Nm electric torque
- Over 93% efficiency
- 150 km/h top speed

Some showcase Elaphe in-wheel powered cars

HYCAT, 2012



Architecture

- Diesel-Electric series Hybrid
- Four in-wheel motors

Key facts

- 4x1000 Nm of torque
- 45% slope climbing with one wheel only

Some showcase Elaphe in-wheel powered vehicles

Ardenner, 2015



Cooperation with
Mattro Mobility
revolutions

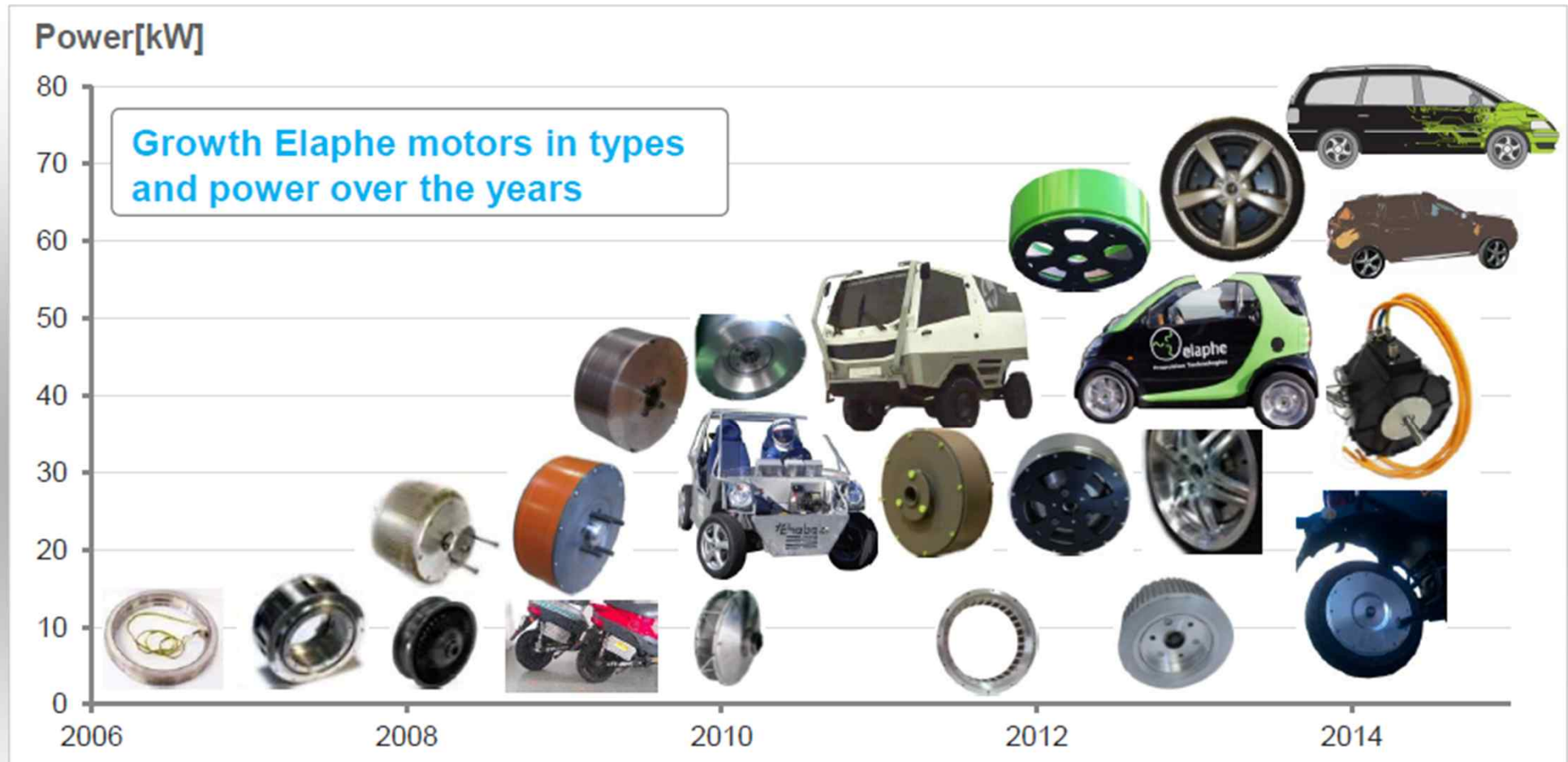
Architecture

- Fully electric
- Two in-wheel motors in front tracks

Key facts

- 2×700 Nm torque
- Elaphe 600 Arms, 100 V controllers
- Turning by torque vectoring
- Series production in 2016

Track record

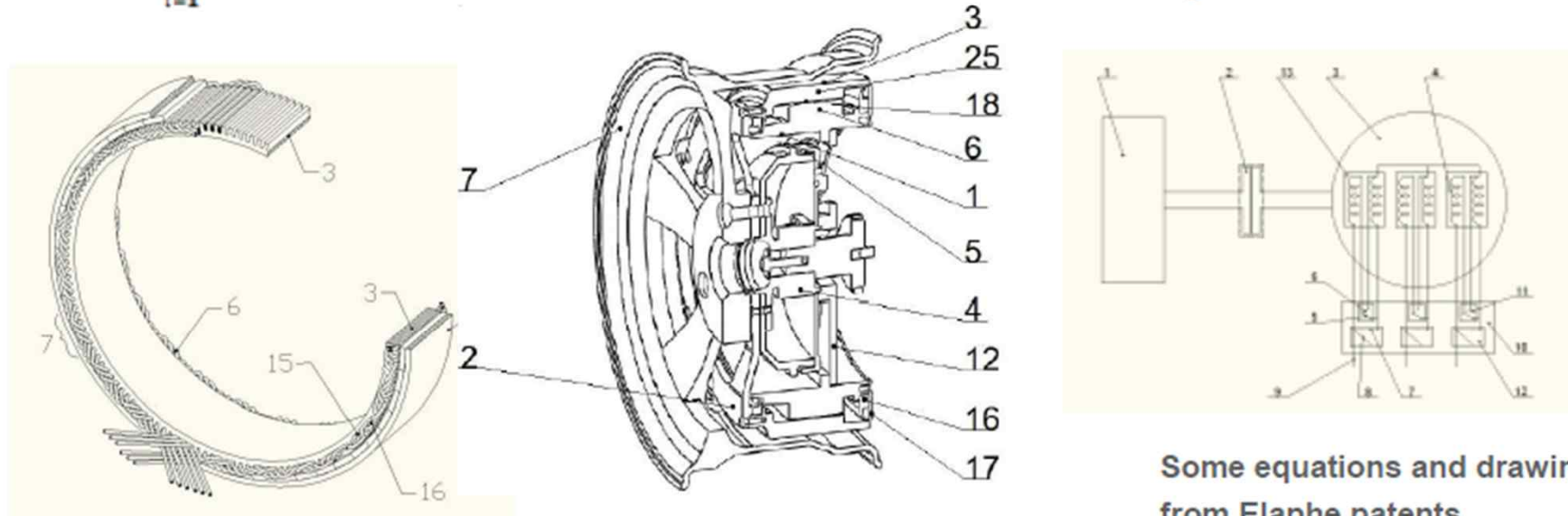


Tried, tested and proven

- According to international standards, safety of the key importance
- Durability tested on the bench and on 10 different vehicles

Patented Elaphe technology

$$f(x) = d + \sum_{i=1}^{i \leq M} A_i \cos(N i k x) \quad \beta_n = \frac{1}{2} \sum_{i=1,3,5,7,\dots}^{i \leq N M-n} a_i (a_{i+n} + a_{i-n}) \quad a_n = \frac{4B_r k}{\pi \operatorname{Sh}[n k s]} \int_0^s \operatorname{Sh}[n k f(x)] \cos[n k x] dx$$

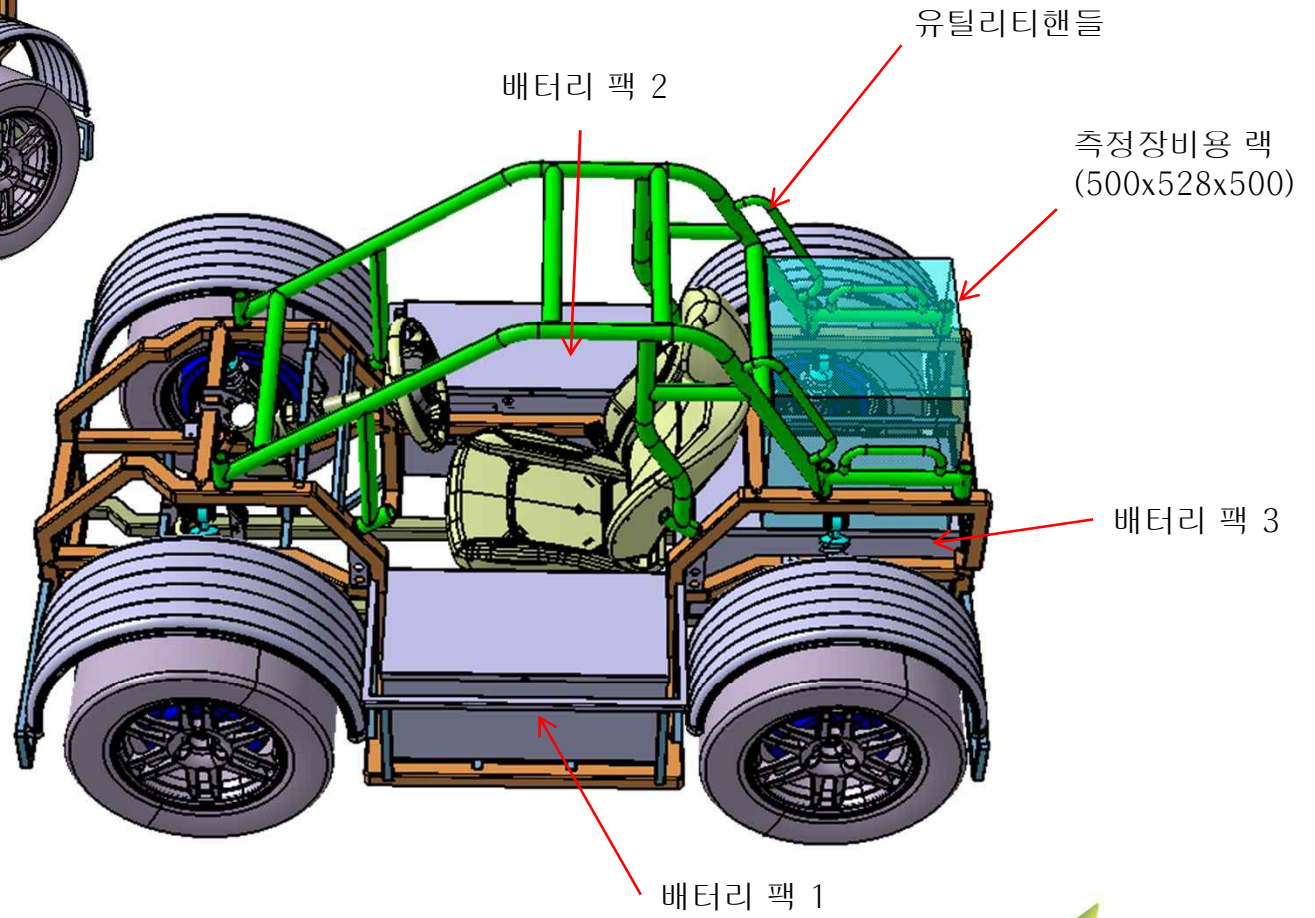
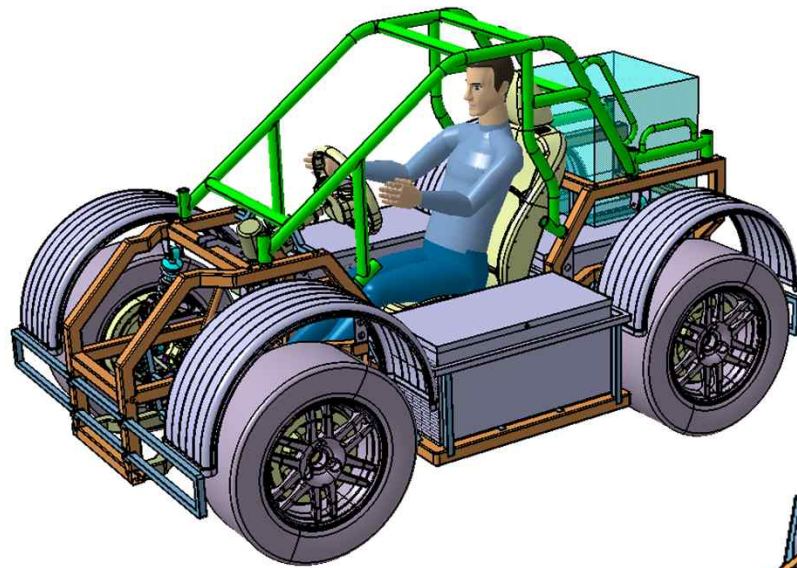


Some equations and drawings from Elaphe patents

Your business is covered by Elaphe IPR

- Patented electromagnetic topology
- Patented mechanical design
- Several new patents in the pipeline
- Over 2000 competitive patents analysed

System Configuration



System Configuration

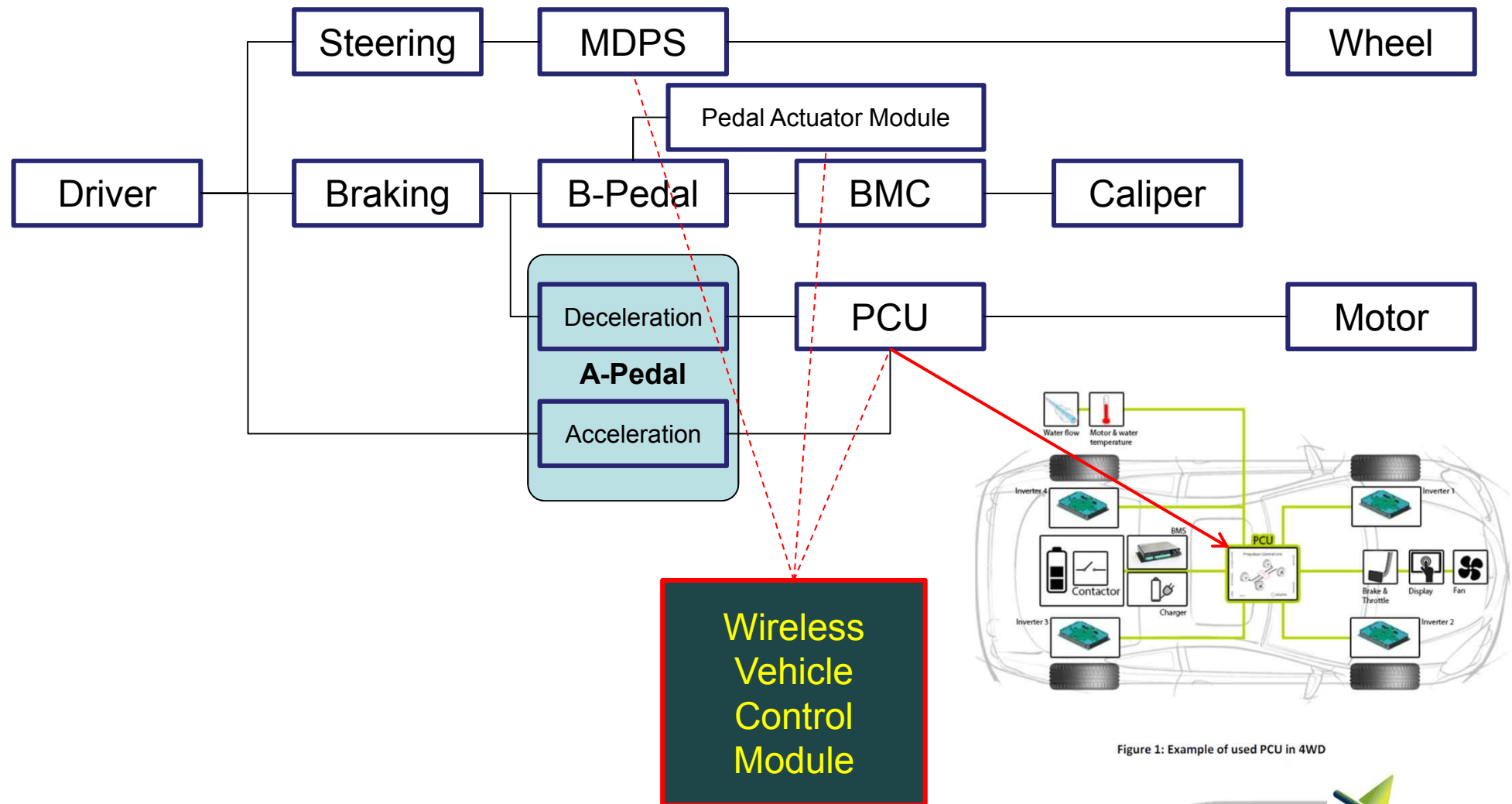


Figure 1: Example of used PCU in 4WD

System Configuration

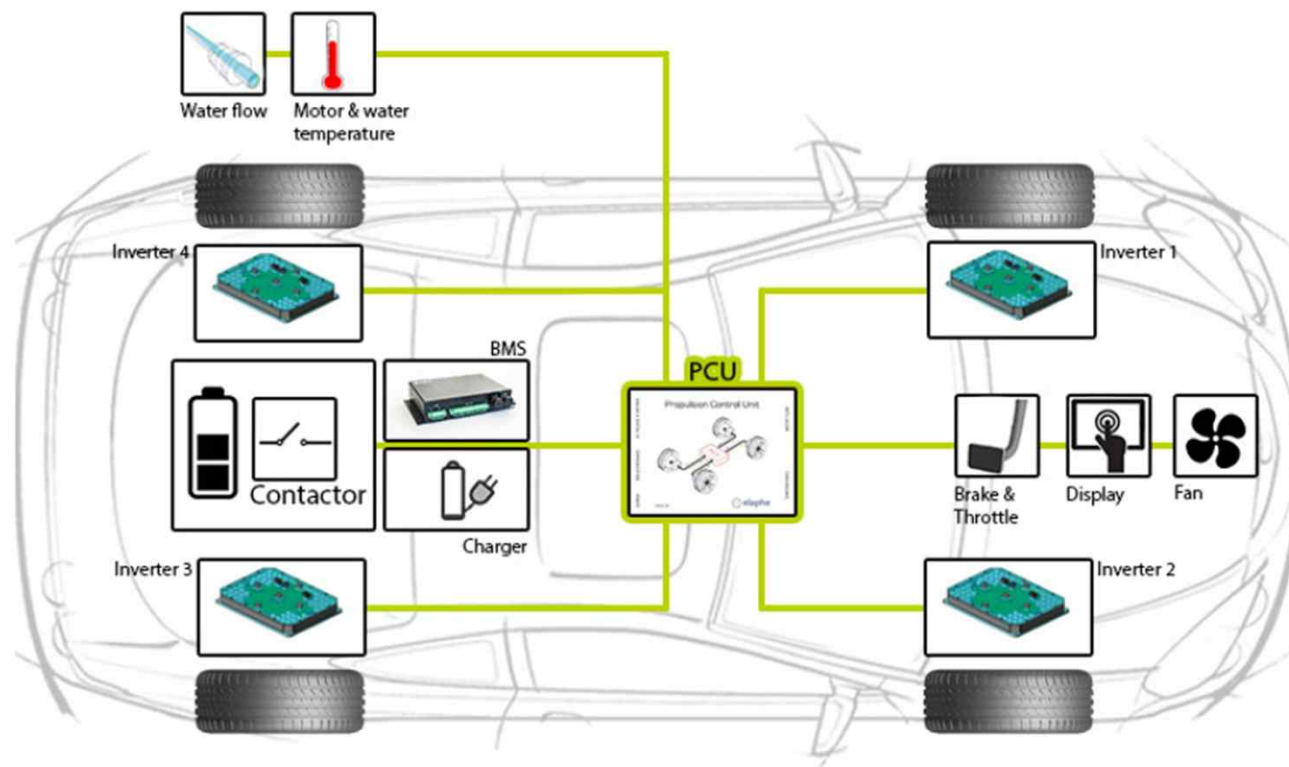
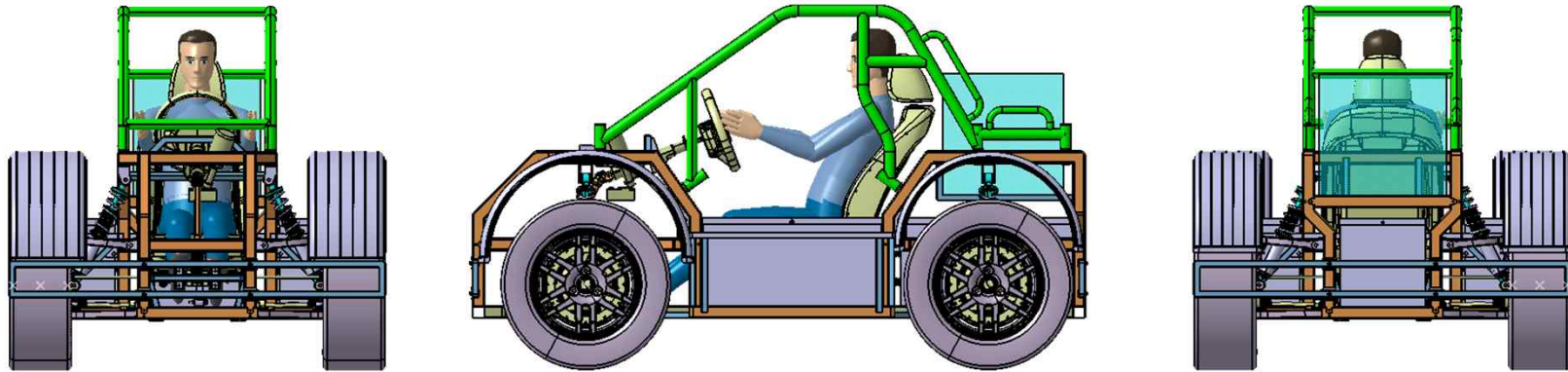


Figure 1: Example of used PCU in 4WD

일반 제원



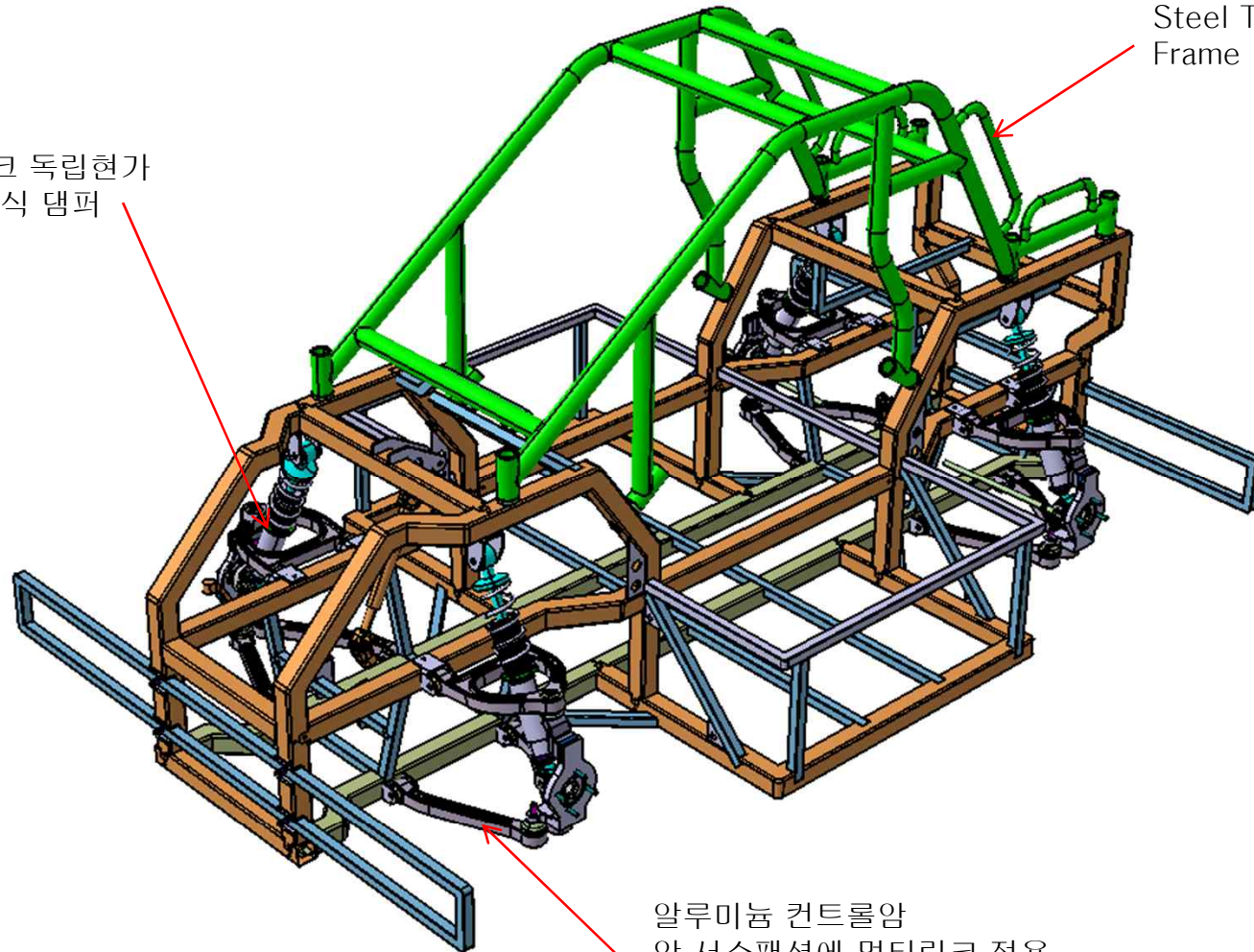
크기	2,600 x 1,560 x 1,500
축거	1,670
윤거(전/후)	1,300 / 1,300
지상고	190
Overhang(전/후)	495 / 435
전입각/탈출각	29° / 37°
탑승인원	1
타이어	255/50 R17
휠	7.5J R17
현가장치	Multi Link with Coil Over SABS
제동장치	In-Motor Drum Brake
조향장치	Rack & Pinion with MDPS
중량(NVW/GVW)	900 kg / 1100 kg

구동 모터	Elaph M700
모터 출력(상시/최대)	33 kW / 45 kW
모터 토크(상시/최대)	400Nm / 700Nm
구동 전압	100 V
모터 갯수	4
전지	LFP300AHA
Nominal Voltage	3.2V
용량	300 Ah
ODC	100 A
MDC	600 A

각부 기능 및 설계 컨셉

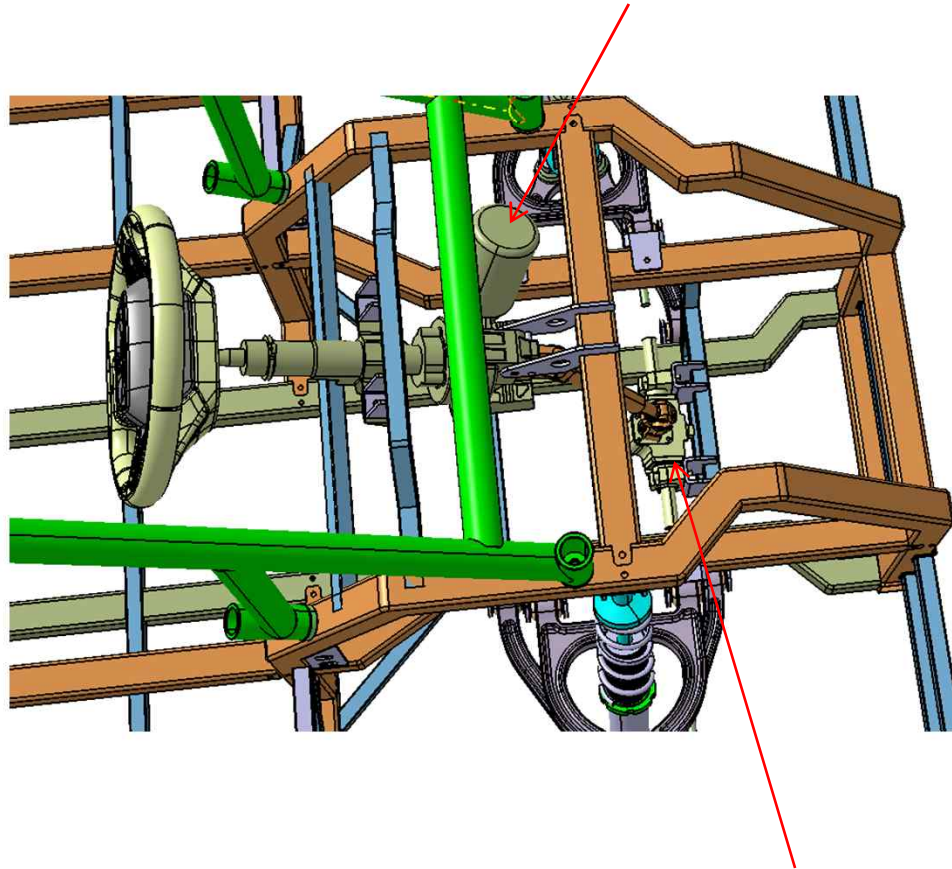
4륜 멀티링크 독립현가
감쇠력 조절식 댐퍼

Steel Tube Space
Frame : 150kg



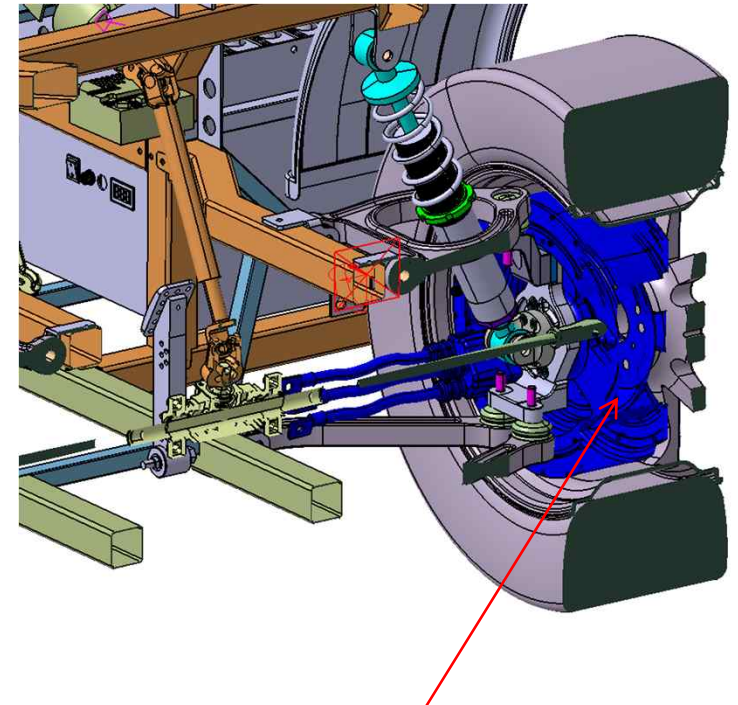
알루미늄 컨트롤암
앞 서스펜션에 멀티링크 적용
으로 최적의 King Pin Offset
확보

MDPS (Motor Driven Power Steering) Module



Steering Ratio 11 : 1

Rack & Pinion Gear Box



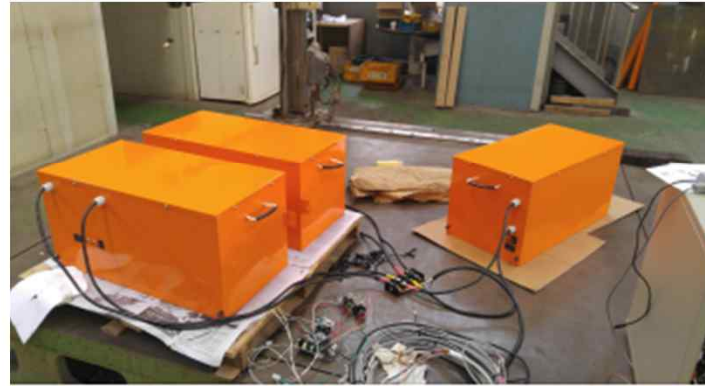
In-wheel Motor

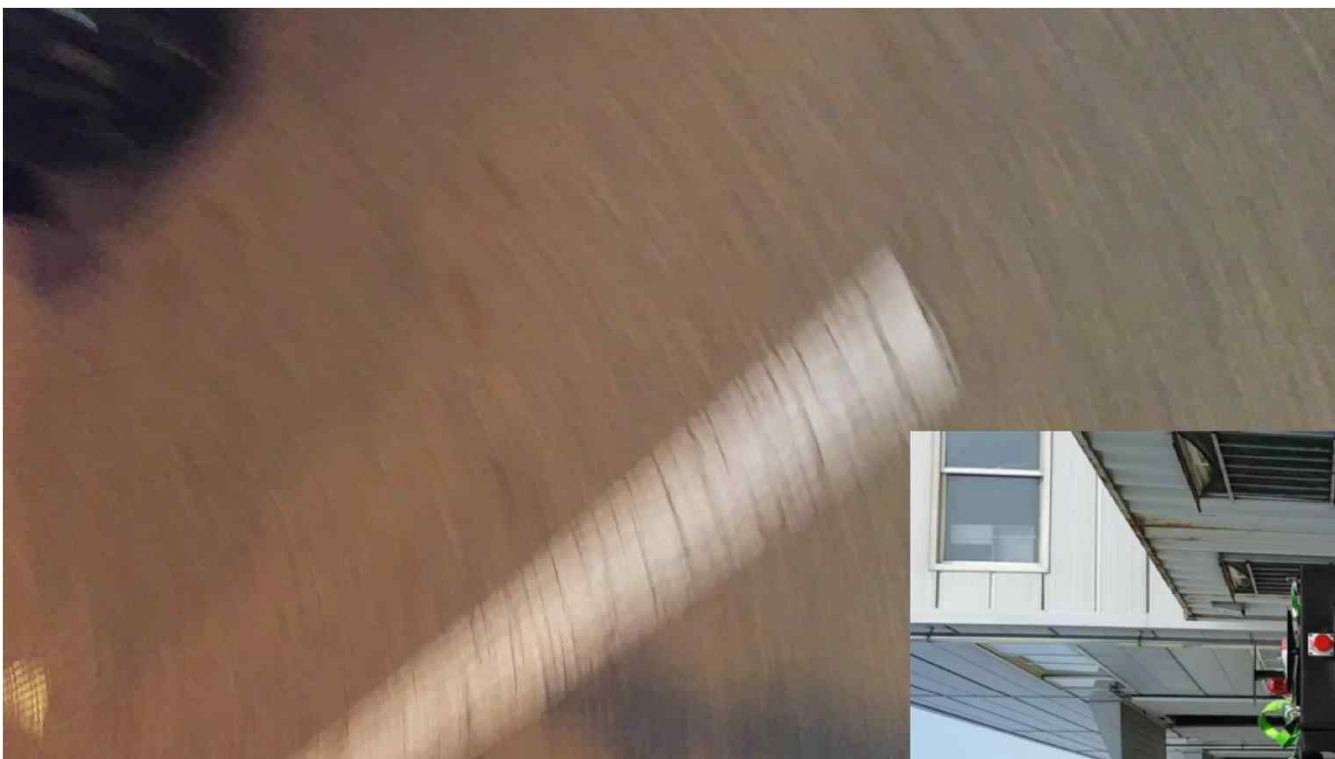
제작 완성품 사진





제작 완성품 사진

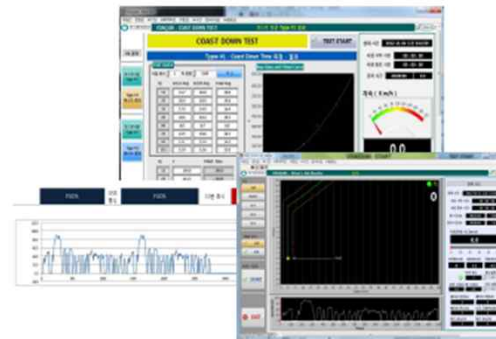
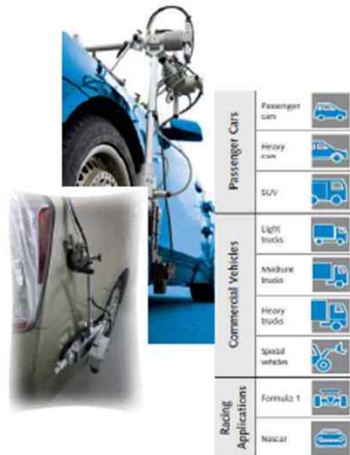




Spacesensing IWM Vehicle
Other projects



Spacesensing IWM Vehicle Other projects



설립일	2003년 9월 19일
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홈페이지	www.spacesensing.com

감사합니다.

Spacesensing Co., Ltd