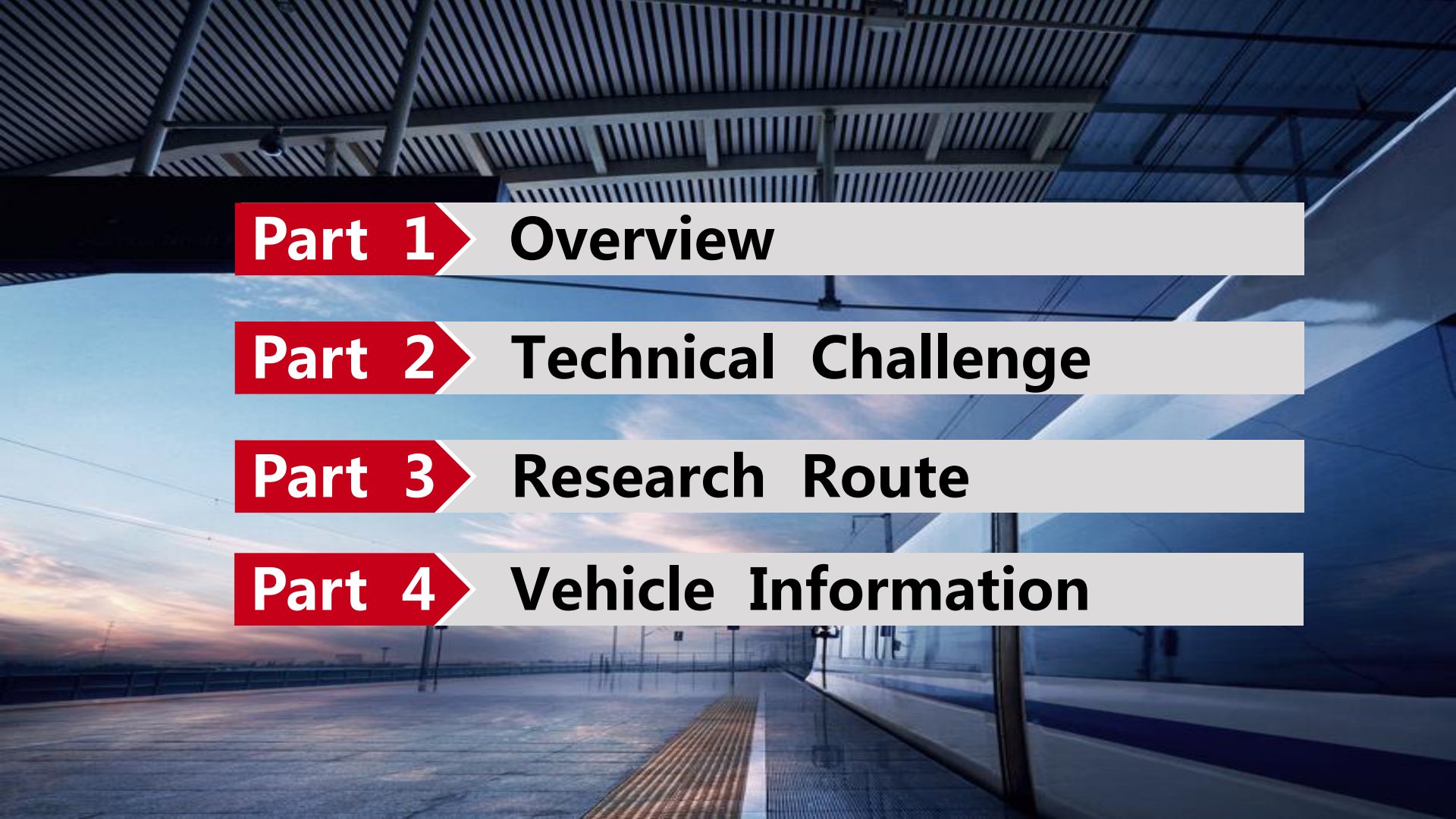


Research and development of EMU for extremely cold or sandstorm area

Speaker : Wang Dong

23 June 2017



Part 1 Overview

Part 2 Technical Challenge

Part 3 Research Route

Part 4 Vehicle Information

A high-speed train, likely a Shinkansen, is shown in motion, blurred to indicate speed. The train is white with blue accents and is traveling on tracks. The background shows a large, modern train station with a glass and steel roof structure.

01

Overview

Basic situation of climate/railway lines in China

中国气候类型



China Railway Map



Ha-Da high speed railway

- Start & End station : Haerbin-Dalian , 23 stops
- Line length : 921 km
- Design velocity : 350km/h
- Service time : December 2012
- Lowest temperature : -38.3°C(Feb.2001)
- Snow situation : average 30 snow days/year

Maximum snow thickness 27.1cm



Lan-Xin high speed railway

The first high speed railway in the blown sand environment in northwest area

- Start & End station : Lanzhou-Wulumuqi , 22 stops
- Line length : 1776 km
- Design velocity : 250km/h
- Service time : December 2014



Lan-Xin high speed railway

- Lowest temperature : -41.5°C in historical records
- Highest temperature : $+47.7^{\circ}\text{C}$ in historical records
- Altitude : 1500~3000m(50.6%) , max 3600
- wind & sand : 5 wind regions , 56.6m/s in historical records
grit diameter 0.075~0.5mm
- **Ultraviolet** : Maximum radiation intensity level 5
radiation quantity $\geq 30\text{w/m}^2$ UV index ≥ 10
- **Long journey** : 1776km

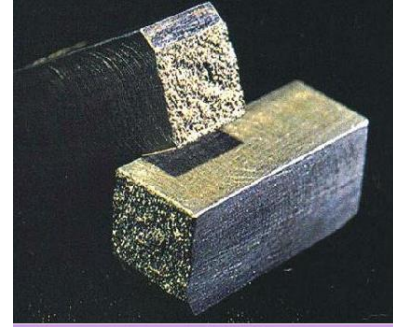


02

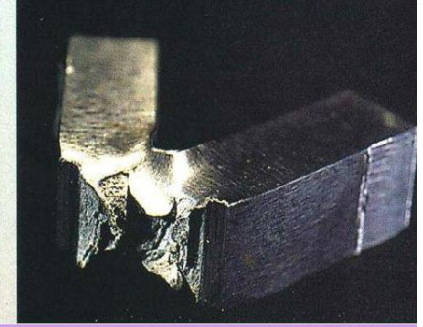
Technical Challenge

可靠性Structure reliability

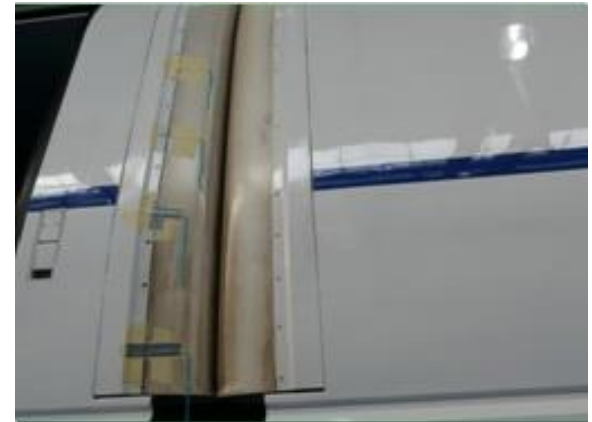
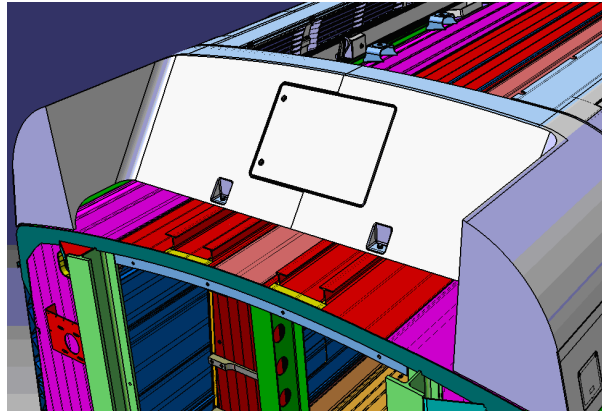
- ductile-brittle transition temperature
- reliable installation
- reliability of valves/sensors
- lubricant / lipid
- rubber



brittle fracture

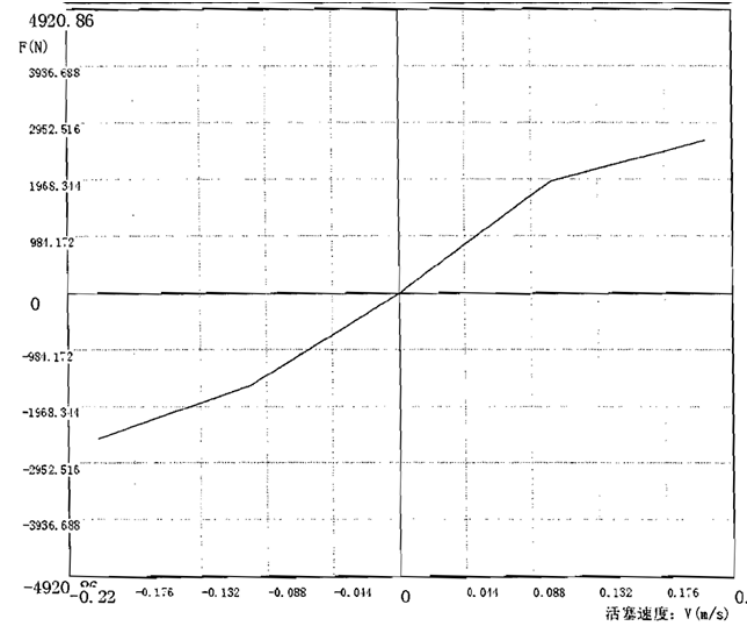


ductile fracture

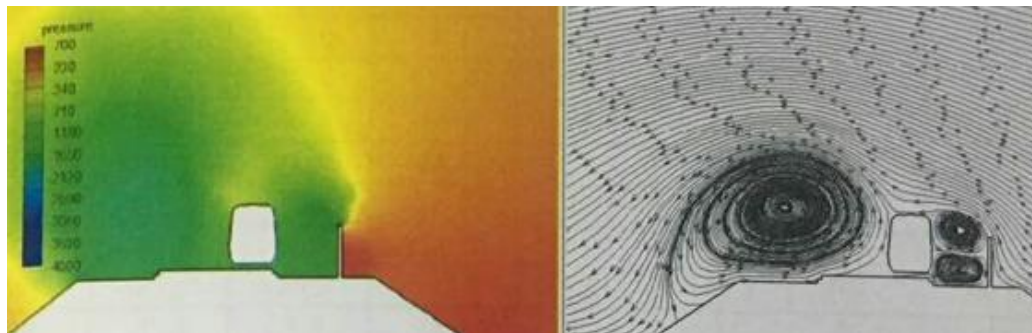


动力学 Vehicle dynamic performance

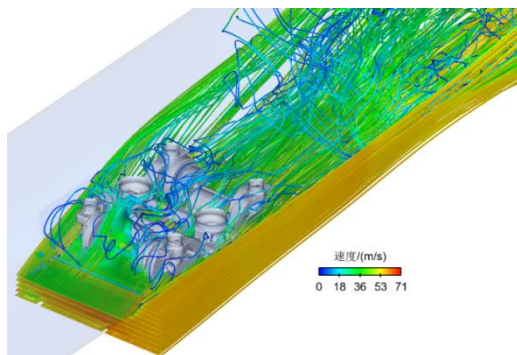
- suspension parameters for low temperature
- cross-wind stability
- wheel-rail wear



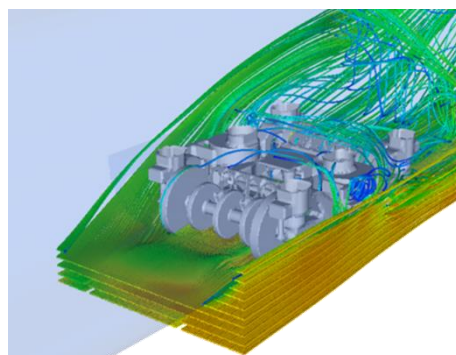
空气动力学 Aerodynamic performance



wind velocity (m/s)	25	30	>33
EMU Max speed (km/h)	200	160	outage



Original flow field



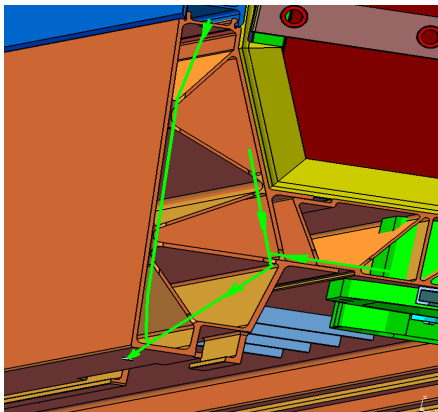
Optimized flow field



fairing

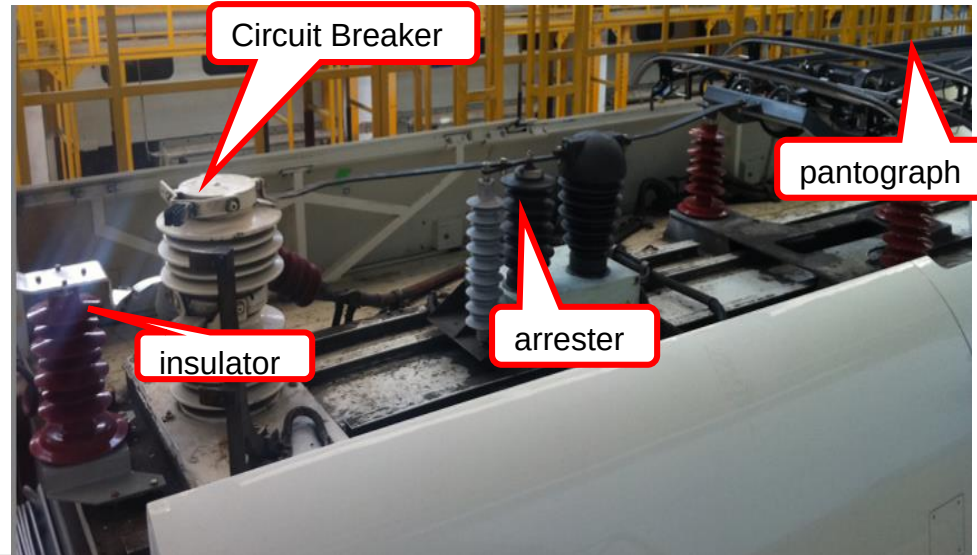
低温适应性 Low temperature adaptability

- condensate
- heat tracing
- sealing



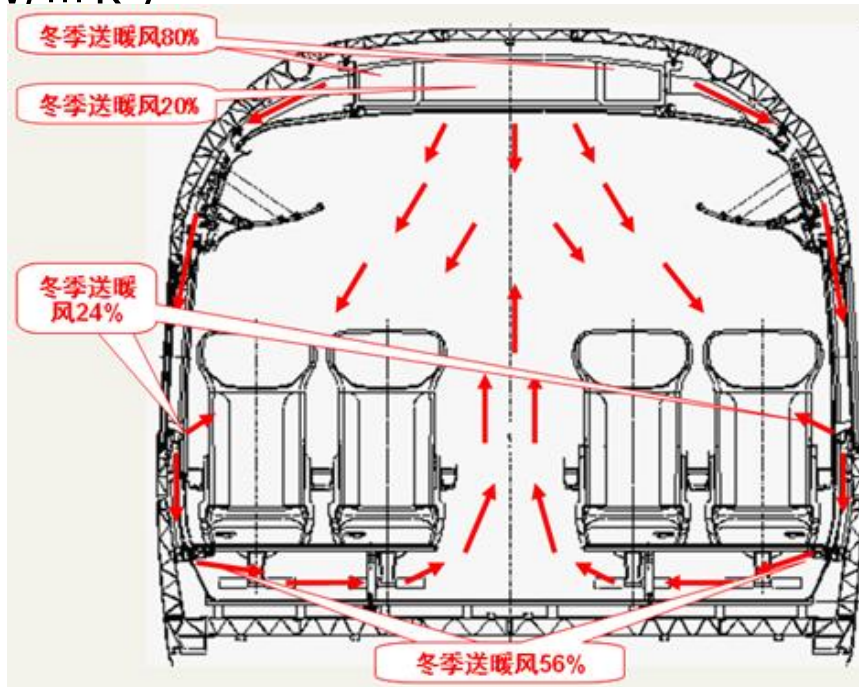
高海拔/强风沙适应性 Attitude/wind adaptability

- impact on high voltage components
- impact on traction/pneumatic devices
- anti-sand hit ability
- preventing & clearing sand



舒适性 Comfort

- Heat transfer coefficient K ($1.1 \sim 1.2 \text{ W/m}^2\text{k}$)
- Air conditioner
 - 40~+40°C outside, 22~25°C inside





03

Research Route

- comprehensive survey, identify key technical issues
- simulation and experiment (components、 EMU)
- make special documents
- auxiliary measurements

动车组冬季运用执行文件		
序号	文件名称	版本年份
1	动车组冬季运营机务部门操作注意事项	2015年
2	动车组冰雪天气检修重点注意事项	2015年
3	CRH380BG/CRH5型动车组融冰除雪操作规范及出库标准	2015年
4	CRH380BG型动车组制动盘异常磨损情况下单轴切除办法	2015年
5	关于动车组冰雪天气限速的建议	2015年
6	CRH5型动车组齐齐哈尔地区冬季库外停放建议	2015年



Contrast before and after
using anti-snow coating



04

Vehicle Information

CRH380BG



Design velocity	350 km/h
Formation type	8-car formation 4M4T
EUM length/width/height	~203 m/3257 mm/3890 mm
Seating capacity	556 passengers
Traction power	9200 kW
Axle load	17 t
Average acceleration (0~200km/h)	$\leq 0.4 \text{ m/s}^2$
Environment temperature	-40°C ~ + 40°C
Altitude	$\leq 1,500 \text{ m}$
Wind speed	15m/s commonly (occasionally 33m/s)

CRH5G



Design velocity	250 km/h
Formation type	8-car formation 5M3T
EUM length/width/height	~211 m/3300 mm/3900 mm
Seating capacity	613 passengers
Traction power	5500 kW
Axle load	17 t
Average acceleration (0~120km/h)	$\leq 0.3 \text{ m/s}^2$
Environment temperature	-40°C ~ + 40°C
Altitude	$\leq 3,600 \text{ m}$
Wind speed	15m/s commonly (occasionally 33m/s, suitable for Lan-xin railway line)

CRH2G



Design velocity	250 km/h
Formation type	8-car formation 4M4T
EUM length/width/height	~200 m/3300 mm/3860 mm
Seating capacity	613 passengers
Traction power	4800 kW
Axle load	15 t
Average acceleration (0~120km/h)	$\leq 0.3 \text{ m/s}^2$
Environment temperature	$-40^{\circ}\text{C} \sim +40^{\circ}\text{C}$
Altitude	$\leq 3,600 \text{ m}$
Wind speed	15m/s commonly (occasionally 33m/s, suitable for Lan-xin railway line)



Thanks