Electrification and Automation: Integration Opportunities to Improve Energy Efficiency and the Travel Experience

November 8th 2018
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ZF’s View of the Future – Vision Zero
Introduction to ZF

Who is ZF?

- ZF is a global leader in vehicle driveline and chassis technology, as well as active and passive safety systems. The company has a global workforce of 146,000 with approximately 230 locations in 40 countries. In 2017, ZF achieved sales of $42 billion and as such, is one of the largest automotive suppliers worldwide.

- ZF enables vehicles to see, think and act. The company invests more than six percent of its sales in research and development annually, particularly for the development of efficient and electric drivelines, and also in striving for a world without accidents. With its broad portfolio, ZF is advancing mobility and services for passenger cars, commercial vehicles and industrial technology applications.
ZF in Michigan

- ZF North American Headquarters in Livonia, MI
- More than 4,500 employees in 11 locations across Michigan; of a total of 13,000 employees in the USA
- Product Development in Farmington Hills, Livonia, Northville, Washington Township; test tracks in Locke Township and Brimley
- Manufacturing facilities in Fenton, Fowlerville, Lapeer, and Marysville
- Key technologies developed in Michigan:
  - Advanced Driver Assist Systems
  - Airbag Control Electronics & Crash Sensors
  - Stability Control & Regenerative Braking Systems
  - Electric Steering Systems
ZF Mission for Energy-Efficient Technologies

- Energy efficiency has always been important, particularly in Germany. Like many German-based automotive companies, ZF has designed and produced energy-efficient products for decades, because efficiency is a core mission of the company.

- Germany has a strong environmental culture, and is a global leader in technology development and R&D

- German companies including ZF have a long history in powertrain development, and in particular the development of high-efficiency powertrains

- ZF has been designing and manufacturing transmissions for more than a century, with continuous improvement in performance and efficiency

- More recently, this has led to the development of hybrid transmissions incorporating electric motors, and complete electric drivetrains for passenger cars and commercial vehicles
Differences between Germany and USA Markets

ZF’s customers have different technology requirements in the USA and German markets, due to significant differences in the driving environment:

- Population density: 250/km² vs. 32/km² – leads to different typical driving conditions, and different types of vehicle crashes
- Fuel prices: USA = $~3/gallon vs. Germany at $6-7/ gallon for gas
- Vehicle fleet: 70% of new light vehicles in the USA are SUVs and light trucks; ~2/3rds of European cars are compacts or smaller
- Typical commute distances are longer in the USA (16 miles vs. 10 miles), less public / mass transport
These variations in the driving environment lead to different technology needs for our customers. For example:

- In Europe ZF developed a prototype electric city car with a turning circle of 6.5m (~20 feet), which can park in a space automatically only 0.6m (2 feet) longer than itself, while
- In the USA, ZF has developed a rear steering system for pickup trucks which can reduce their turning circle by 20% (from 48 feet to 38 feet in this case, or about the same as a compact SUV)

- ZF’s sales of hybrid passenger car transmissions are higher in Europe, due to the higher fuel prices
VISION ZERO

0 emissions

0 accidents
ZF Technology Focus

**ZF Vision Zero**

ZF is consistently pursuing the goal “Vision Zero” – mobility with zero accidents and zero emissions.

- Zero Emissions
- Zero Accidents

**ZF Technology Focus**

Megatrends in mobility include efficiency, highest safety levels, autonomous driving, and connectivity.

- Automated Driving
- Efficiency
- Integrated Safety
- Vehicle Motion Control

**ZF Approach**

ZF combines sensor, computing and intervention technologies for safety systems of future vehicles.

- See
- Think
- Act
ZF’s Broad Technology Portfolio

- DRIVER ASSISTANCE SYSTEMS
- OCCUPANT SAFETY SYSTEMS
- CHASSIS COMPONENTS
- ELECTRIC DRIVES
- STEERING SYSTEMS
- AXLE SYSTEMS
- ELECTRONICS
- DAMPING SYSTEMS
- AXLE DRIVE UNITS
- ACTIVE CHASSIS SYSTEMS
- BRAKING SYSTEMS
- TRANSMISSIONS
ZF Technologies for Automated Driving

SEE

SENSING

THINK

DATA PROCESSING

ACT

ACTUATION
ZF Technologies for Vehicle Electrification

Hybrid transmission

Hybrid module

Hybrid components

E-Motor + Power electronics + Functions + Clutches + Torsion dampers + Functions + Transmission + TCU + Sensor Cluster + Functions

Electric axle drive system

Integrated Axle

Electric Vehicle Drive
ZF Automated Driving and Electric Systems Integration

- Today we can use information about the road environment (e.g. geometry, gradient) to improve powertrain efficiency for internal combustion and electric vehicles – for example by automatically downshifting at the base of a hill to a more efficient gear.

- In future we can use real-time radar/ lidar/ camera sensor data to understand the dynamic environment and optimize vehicle speed, acceleration and deceleration rates based on impeding vehicles and traffic controls (traffic lights, stop signs, speed limits etc.).

- This results in improved powertrain efficiency and fuel consumption/ C02 emissions reduction for gasoline vehicles, and optimized energy consumption and recovery in hybrid/ electric vehicles.
  - Adaptive control of vehicle speed improves passenger comfort by matching acceleration and deceleration needs to the driving environment.
Do Automated Vehicles Need to be Electric?

- Vehicle automation and electrification are parallel trends in the automotive industry
- Today’s prototype automated vehicles typically use general-purpose, PC-based development environments, with high power consumption (e.g. >1kw)
- However, production automated vehicles will use dedicated embedded processing platforms such as ZF’s ProAI computing platform (co-developed with Nvidia), which are much more energy-efficient
- ZF estimates that an automated vehicle may require an additional 150-200w of energy to power it’s sensors and driving computers in normal driving; about the same as a traditional vehicle lighting system
So, while automated vehicles don’t need to be electric, if electric vehicles are automated this can bring additional benefits to the user.

For example, an automated electric vehicle can drive itself to a remote or shared charging station to recharge while it is not needed, and return when required or once it is fully charged.

This could be of particular benefit at shared charging locations where electric vehicles may be left for extended periods today, such as airports – allowing more efficient use of charging facilities.

Wireless charging systems would make this process even easier to use.
ZF - Michigan State University Engagement

Why ZF?
- Great atmosphere (Recent major expansion)
- Networking events (Social Responsibility & Social Events)
- Opportunities for multiple rotations
- Competitive wages
- Housing/Transportation Stipend, dependent on role
- Benefits (401K enrollment)
- Tuition Reimbursement Program
- Opportunity for Advancement into Entry-Level Positions

Co-op/Internship Opportunities (Targeting 80+ summer positions)
Summer 2019
- Mechanical: 37927BR
- Software: 37925BR
- Electrical: 37926BR
- Global Trainee Program: Details in Application
- Business: Find specific openings (Finance, HR, Supply Chain, etc.) at link below

- Year-round opportunities: ~Winter (Jan-April), ~Summer (May-August), ~Fall (Sept.-Dec.)

Upcoming Events
- Supply Chain Career Fair - January 2019
- Engineering Expo - February 2019
- Engineering Fair - March 2019
- Resume Critiques - TBD

Check Our Website For Opportunity Details:
If interested, please visit www.zf.com/careers to view current open positions and apply.
Thank you