Lane Accurate Position Sensing of Vehicles for Cooperative Driver Assistance Systems

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All Sensing Systems on: Taking the Pulse on Your Safety
Since 1871 with headquarters in Hanover, Germany
Sales of €30.5 billion
163,788 employees worldwide
269 locations in 46 countries
One of the top 5 in the automotive supplier industry
# Lane Accurate Position Sensing

**Continental: Chassis & Safety Division – Business Units**

## Electronic Brake Systems
- Electronic brake systems, e.g. ABS and ESC
- Electric-hydraulic combi brake (EHC)
- Control units for motorcycle brakes
- ABS for motorcycles
- Regenerative brake systems
- Software for extended brake control functions and assistance systems
- Hydraulic valves

## Hydraulic Brake Systems
- Brake disks
- Drum brakes
- Brake calipers
- Parking brakes
- Electric parking brakes
- Brake boosters
- Tandem master cylinders
- Mechanical, electronic and hydraulic brake assist devices
- Brake actuation modules
- Brake pressure regulators
- Brake hoses
- Duo-servo parking brake systems

## Passive Safety & Sensorics
- Inertial sensors for
  - ESC
  - Passive safety
- Satellite sensors for
  - Active chassis control
  - Side crash detection
- Steering angle and torque sensors
- Speed sensors for wheels, engines and transmission
- Passive safety control unit
- Occupant classification

## ADAS
- Driver assistance systems
  - Adaptive Cruise Control
  - Emergency Braking Assist
  - Blind Spot Detection
  - Intelligent Headlamp Control
  - Lane Keeping Assist
  - Speed Limit Monitoring
  - Mono- / Stereo Camera
  - Radar / Lidar Systems

## Chassis Components
- Steering systems
- Air suspension systems
- Chassis electronics
- Electronic components
- Windshield and headlamp cleaning systems

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*Division Chassis & Safety  
Business Unit Passive Safety & Sensorics*  
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Lane Accurate Position Sensing
We Shape the Megatrends in the Automotive Industry

Doing more.
For safe mobility.

Doing more.
For clean power.

Doing more.
For intelligent driving.

Doing more.
For global mobility.
Lane Accurate Position Sensing
Motivation: Emerging Car2X Functions

Cross-roads with oncoming traffic are dangerous situations when turning.
Customer benefit

- Car2X systems starting 2015 enable information exchange between participants and help preventing accidents.
- Collision and hazard warning systems require lane accurate localization of each participating car.

Safety applications: warning / autonomous

- Green light optimal speed advisory
- Local hazard/traffic jam warning

Information only applications

- Traffic sign assist
- TMC

Park assist systems

- Improved up to fully autonomous

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Many standard sensors in today’s vehicles are still operating independently. Redundancy of information is still not utilized. Positioning is optimized for navigation purpose. Fusion of these already available signals leads to a benefit of all involved systems with low extra effort:

- Driver assistance systems, Navigation
- Traffic guidance systems
- Cooperative vehicle communication
Handling the varying sensor data with independent sample times and fuse them to one comprehensive information is the challenging task of the algorithm. Because sensor data arrive sporadically and can also drop out, e.g. GNSS signal in tunnels, the algorithm output has to be extracted from other sensor data. An strapdown-algorithm computes the new position, using the fused data. Since it works independently from the filtering and fusion itself, new position data are available, directly from the input and delay free.
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Error-State-Space-Extended-Sequential-Kalman-Filter
Lane Accurate Position Sensing
Algorithm – Detailed Architecture

SAS
IMU

Assemble odometry data
WSStick, WSSdir
Steering angle
Prepare IMU

Rel. Position determination
based on:
Kalman Filter
Calibration based on: actual position, expected position by means of models, sensor models → Feedback

Information about adaption of models
Information about weighting of models
Odometry: Position change by means of velocity model
IMU: Position change
WSS system (s) Sensors
Preprocessing
Algorithm
Signal proc. / vehicle models
Information fusion
Filter

More Accurate
• Position
• velocity,
• wheel speeds,
• steering angle,
• angular rates,
• accelerations
+ Additional Signals
• precise global GPS time
• slip-angle
• speed-over-ground
• wheel slip...
+ Integrity Measure of the delivered signals

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Lane Accurate Position Sensing

Status Demonstration of Realtime Algorithm Functionality

Blue = GPS position data
Red = M2XPro position data

High buildings, metal front panels

Status and outlook:
- All basic models and filters implemented
- Demo-vehicle set-up with reference system, performance demonstrated
- Optimizing performance of algorithm in some driving situations, start up by fusion parameter studies
- Integrate self monitoring, restart functions, plausibility checks & integrity level

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**Conclusion**

M2XPro is Continental’s reliable answer to lane accurate positioning of cars based on sensor fusion of in-vehicle sensor signals with GNSS.

- Improved accuracy and robustness of relative and absolute position information
- Supply of signal integrity and performance measure
- Use of standard inertial, steering and wheel speed sensors
- Faster and reliable vehicle dynamics signals (even with less satellite contact)
- Fitting into today’s vehicle system architecture
- Enabling cooperative vehicle communication
Nowadays innovation happens so fast that, when somebody declares a thing absolutely impracticable, he gets interrupted by somebody who has already realized it.*

*Translation BS

Albert Einstein
Thank You for Your Attention

☺ ☺ ☺ ☺

B. Schmid

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