CHASSIS SYSTEM DEVELOPMENT

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Chassis & Vehicle dynamics
Chassis Control Systems

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Fiat Auto as other car-makers believes that the introduction on the market of active chassis systems has to guarantee some very important drivers:

- Safety
- Personalisation
- Easy of use
- Handling/Comfort trade off
It is shared between different Car-makers as competitiveness and distinctiveness will be strictly related to their ability to manage and integrate Active Chassis Systems.

Moreover it will be necessary in the next future to deal with the problem concerning the integration of Active Chassis Systems.

To properly manage this rapid evolution Car-makers have realised that it will become a “must”.

Acquisition of the ability to develop and manage proprietary chassis control strategies. Complete management of the functional integration of Active Chassis Systems.
Proprietary Control Strategies are aimed at giving to Active Chassis Systems new and exclusive functionalities, while safeguarding safety and reliability.

Therefore the acquisition of the ability to develop and specify to suppliers those Chassis Control Strategies can become a competitive and distinctive asset in terms of vehicle performances.
Systems:

- Active Roll Control
- Continuous Damping Control
- Controlled Coupling
- Dynamic Steering Torque
ACTIVE ROLL CONTROL
Fiat “Active Roll Control approach”

Fiat Auto has decided the grow up of internal know-how in order to build up specific competencies concerning system packaging, electro-hydraulic aspects, vehicle control and safety strategies design.

This competencies will allow Fiat to play a systemic role in order to be owner of vehicle control strategies.
Active Roll Control approach

- Complete control of chassis movements aimed to reduce roll angle and speed during cornering, without the loss of comfort level.
- Maximum lateral acceleration and traction improvement.
- Active safety improvement:
  - Stability (avoid over-steering in transient conditions)
  - Steerability (reduce vehicle time delay)
  - Driveability (improve handling in traction and power off manoeuvre).
- Comfort improvement under asymmetric road excitation.
Active Roll Control: architectural solution

Dual Channel:

The anti-roll torques on each active axes are the two degree of freedom of control strategy.

Using appropriate control strategies it is possible to generate a total anti-roll torque to compensate the vehicle roll moment. Splitting it on two axes can be also satisfied handling targets both in steady state and transient conditions.

A dual channel system is appropriate for high performances targets and high class vehicles.
**Active Roll Control: architectural solution**

**Single Channel:**

The anti-roll torque on one active axle is the degree of freedom of control strategy.

This solution allows to obtain a compromise between roll and handling targets.

The active axle choice depends on hydraulic manifold design and safety strategies.

A single channel system being simpler than double channel system it is suitable for medium vehicle class.
Active Roll Control: architectural solution

Both actuators are suitable for all active roll control architectures
Continuous Damping Control
Continuous Damping approach

Targets:

• Minimise chassis movement during transient
• Reduce vibration introduced by road surface
• Improve handling during transient by managing front/rear damping distribution
• Improve ABS/ESP efficiency through front/rear damping distribution
Continuous Damping variation range

FORZE MAX DI ESTENSIONE A 1.6 A
+17% a 600 mm/sec

FORZE MAX DI COMPRESSIONE A 1.6 A
+49% a 600 mm/sec

Front Shocks Reference Curves
Continuous Damper
CONTROLLED COUPLING
Controlled Coupling approach

Targets:

• Manage front/rear torque distribution of an 4WD transmission in order to:
  • Maximise the traction
  • Improve the stability
  • Reduce the fuel consumption

• Complete brake/ABS compatibility

• Complete control vehicle system compatibility
CONTROLLED COUPLING

Controlled Coupling: physical layout
DYNAMIC STEERING TORQUE
The DST can be conceived as a number of coordinated SW modules able to give an incremental performance to the conventional ABS, VDC and EPS systems. Each of the currently developed SW modules covers a specific integration area in the aside three-circles DST sketch.

At Fiat Group Automobiles the DST is going to be applied on three incoming models.
MAIN OBJECTIVES OF THE INTEGRATION

- Improvement of the capability to maintain the vehicle attitude when braking on $\mu$-split

- Improvement of the vehicle stability in case of critical dynamic transients for both, 1) reducing overshoot during transient and 2) reducing transient period before reaching the steady-state conditions

- Augmentation of the safety perception on board vehicle as function of the lateral dynamic scenario
Toward system development and integration

The increasing introduction of “active” system even into low-end car segments, shows that time has come to move from the “add-on“ to an integrated management approach.

In facts it is not any more possible to consider Chassis Control Systems as “stand-alone” devices: their interaction must be managed not only to comply with manual constraints, but above all to reap all additional benefits steaming from integration.

Car-makers today cannot do without directly managing the integrated systems, since their involvement constitutes an enabling factor to both overcome integration problems of systems developed by different suppliers, and to pursue/improve a clear product distinctiveness together with cost and performance optimisation.