

## Safebike Stability Control by Advanced Full-Braking Systems of 2-Wheel Motorbike Vehicles

The continuously increasing traffic in the main European urban areas and the need of reducing the vehicle emission are rapidly stimulating the diffusion of 2-wheel vehicles for the urban-area mobility. Stability control of these vehicles in critical conditions (wet roads with non uniform pavement) is extremely critical and represents a major obstacle for the diffusion of this kind of vehicle, as well as a substantial safety problem. To overcome the lack of safety, the groups of participating regions (Linz, Milan and Győr) investigate alternative concepts for a curve-save ABS and stability system for 2-wheel vehicles.

### Problem/needs addressed by the sub-project

At the current development stage, 2-wheel vehicles are not equipped with brake-based stability-control systems (like ESP), which are customary on 4-wheel vehicles; standard ABS strategies (on the front or on both wheels) are used. Interestingly enough, a standard ABS strategy applied on both the front and the rear wheel, is a very poor control approach in a 2-wheel vehicle, from the stability point of view: as a matter of fact, a standard ABS strategy allows strong slip overshoots (60-70% slip can be easily reached) and controls the slip over a wide range (10%-40%). This approach is acceptable on 4-wheel vehicles, since the lateral friction is the average of two wheels; however, this approach is very poor if applied to a 2-wheel vehicle during a turn (when lateral forces are required), since the lateral forces of one or two wheels may take very small values for short time. This can strongly undermine the stability of the vehicle and is the main reason of many road accidents.

### Statements and thoughts

#### Sergio Savaresi – Project Team Leader Milan

Electronic control of the dynamics in 2-wheel vehicles is leaving its infancy stage. Automatic-control of suspensions is the next step, but the really big challenge is stability-control. When ESP-like systems will be available for 2-wheel vehicles, motorbikes will finally become the road vehicles with the best mix of driving-fun and safety.

### Interested companies

We want to acknowledge the interested companies:

- KTM-Sportmotorcycle AG
- Brembo
- ST-Microelectronics
- Datron-Technology GmbH
- MIBA Frictec GmbH



Participants of the Safebike Meeting in Milan

### Objectives of the sub-project

The main objective of the Sub-Project SAFEBIKE is to study and develop an automatic control system (similar to the ESP or Electronic Stability Control system in 4-wheel vehicles) aimed to strongly improve the stability of 2-wheel vehicles (motorbikes or scooters). The specific objectives are the understanding of the causes of the stability problems to define methods and ideas to obtain a safe control and to test the results in a simulated environment. As a solution, we think both at new control algorithms as well as extend some concepts of the 4-wheel stability programs for motorbikes.

### REGINS project partner

REGINS (REGional standardised Interfaces for a better integration of regional SMEs in the European Economy) is an INTERREG I I I C Regional Framework Operation (RFO) that aims to support interregional cooperation projects (Sub-Projects) within the thematic priorities automotive, biotechnology and logistics within the participating partner regions Upper Austria, Stuttgart Region, Lombardy Region and West-Pannon.

## Summary/activities of the sub-project

A kick-off meeting was held in May to introduce the participants among each other and the interested companies. To define the state of the art intensive literature investigation was done. In particular for data exchange and discussion a homepage has been released (<http://safebike.jku.at>).

In Milan a comparative evaluation of different software environments and packages for the development of a software simulator, suitable for the design and testing of stability control algorithms of a motorbike, were performed. Within this activity, several software packages have been evaluated and tested. Simulink has been selected as the main SW platform for the projects, since (with regard to the objectives and scope of the project) it is the best compromise among technical effectiveness, cost, usability, and users' awareness.

A hydraulic model of the brake circuit was developed in Linz, able to simulate ABS manoeuvres. In Győr a motorcycle was equipped with plenty of sensors to perform accurate measurements, in particular the behaviour of the tilt bike.

## Contribution to strategic goals of REGINS

Due to already existing strong contacts to regional companies, the know-how transfer of the regional partners (Linz, Milan and Győr) activated with the sub-project has excellent chances to become a permanent cooperation, also beyond the time/scope limits of the REGINS sub-project. Based on this we can increase the competitiveness of the regions through the involved project partners.

The planned meetings and short visits will provide a strong exchange of experience of partners in Milan (experts in the field of advanced control in automotive applications), Linz (researchers for automotive control, and in modelling and control of hydraulic systems) and Győr (with significant expertise in data-acquisition in vehicles).

Info Letters will be published, a homepage has been created and a final session will be held, where all the results of the sub-project are presented to academic institutions and private companies of the three partner regions, interested in sub-project.

The strength of the proposed sub-project is stressed by the fact that regional private companies are strongly interested in the project, which will help to strengthen the cooperation between the academic institutions, with strong theoretical background and private sectors with high experience.



Representatives of the Lombardy Region at the Meeting in Milan

## Facts and figures

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|-------------------------|--|---|
| Name of the sub-project | <b>Safebike</b> - Stability Control by Advanced Full-Braking Systems of 2-Wheel Motorbike Vehicles |   |
| Duration                | April 25 <sup>th</sup> 2005 – March 24 <sup>th</sup> 2006  |   |
| Lead partner            | Institute for Design and Control of mechatronical Systems, JKU Linz                                | Luigi del Re; +43-732-2468-9773<br>luigi.delre@jku.at           |
| Project partner 1       | Dept. of Electronics and Information Technology, Politecnico di Milano                             | Sergio Savaresi +39-02-2399-3545<br>savaresi@elet.polimi.it     |
| Project partner 2       | Inst. of Transportation and Mechanical Eng., Széchenyi István University Győr                      | Zoltan Varga; +36-96-503-495<br>vargaz@sze.hu                   |
| External expert         |  |   |
| REGINS contact person   | TMG - Upper Austrian Technology and Marketing Company  | Andreas Hubinger; +43-732-79810-5082<br>andreas.hubinger@tmq.at |

