

**By-Wire Applications with Time-Triggered Technology**  
**SKF-Stile Bertone's FILO Concept Car**

***TTTech***

"As the drive-by-wire systems for brakes, steering and gearbox control interact with each other, the communication must be fault-tolerant. Accordingly, the FILO car uses time-triggered technology from TTTech to exchange information between the three main systems fault-tolerant and in real time."

Steven F. Brown  
North-American Programs Director Drive-by-Wire  
SKF Automotive Division



The FILO concept car was the outcome of a joint development between SKF and Stile Bertone. Based on the drive-by-wire technology, it replaces many of the traditional hydraulically and mechanically operated systems with by-wire systems. Such applications convert electrical to mechanical energy and use digital signals to control the system actuation. The deployment of by-wire systems for brakes, steering and gearbox control enabled the revolutionary design of the FILO.



Stile Bertone seized the opportunity to redesign the interior architecture of the automobile. The Guida, the driver's control unit of the FILO, blends familiar design elements from today's proven man-machine interface with the benefits of full by-wire operation. Throttle, braking and steering are presented as hand controls in a single unit, gear selection is made by a button system. Lights, windscreen wipers, audio, heating and air conditioning are all located within the driver's immediate reach.



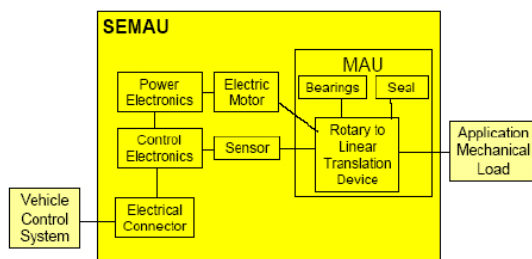
FILO's brake-by-wire system deploys SKF's electromechanical actuating units and hub-bearing designs. The braking system control is mounted on the Guida and is activated by squeezing handgrips. The mechanical design of the driver's braking controls incorporates a progressive resistance and a small, but clearly discernible, free-play at the beginning of the movement. This provides the driver with a tactile indication that the brakes start to operate.

“Since our actuation control units interpret the signals coming in from the many sensors and control inputs, we incorporated TTTech’s protocol. As a matter of fact, this robust and fault-tolerant network operating system runs the data backbone within the FILO’s complete by-wire architecture.”

Bernie van Leeuwen  
Project Manager  
SKF Automotive Division



All of the FILO’s by-wire systems are controlled by SKF’s drive-by-wire technology. At the heart of each by-wire system there is a smart electromechanical actuating unit (SEMAU) under intelligent control. A SEMAU combines the actuator, the controller and logic, and the power supply in a single mechatronic arrangement. Signals from the driver’s control unit are interpreted by logic systems that ensure appropriate behavior from the individual by-wire systems.



The actuation control units are sophisticated computer-controlled power-switching units that interpret the signals coming in from the many sensors and control inputs and provide electrical power to the SEMAU’s brushless electric motor. To achieve the required degree of reliability, these units incorporate TTTech’s time-triggered solutions and communication network that runs the data backbone within the FILO’s complete by-wire architecture.



The time-triggered communication system allocates specific blocks of time to each of the connected nodes. On each allocated time block, the specific node must acknowledge that it functions correctly. If it wishes to carry out an operation, a message is transmitted via the network to the actuator’s controller. The network checks continually if all nodes are connected and respond accordingly when polled. In this way the time-triggered solutions ensure the reliability of FILO’s complete network and can take appropriate action in cases of failure.

### **About TTTech Computertechnik AG**

TTTech Computertechnik AG is the leading supplier of solutions in the field of time-triggered data communication. The company's products improve the safety and dependability of networked computer systems in transportation and automation industries. The solutions are based on TTP and TTEthernet. FlexRay offerings are provided by TTTech's subsidiary, TTTech Automotive.

Further information is available at  
**[www.tttech.com](http://www.tttech.com)**

### **About SKF**

SKF is a leading global supplier in the areas of bearings, seals, mechatronics, services and lubrication systems. The Group's service offer includes technical support, maintenance services, engineering consultancy and training. SKF has 110 manufacturing sites distributed all over the world and is represented in 140 countries through some 15 000 distributors and dealers.

Further information is available at  
**[www.skf.com](http://www.skf.com)**

### **About Stile Bertone**

Stile Bertone is an independent company operating in the sector of transportation design, working in the areas of design, engineering, model making, prototyping, concept and one-off cars. The service is based on excellence that derives from the experience of its specialists, from the organization of its structure and from its use of cutting-edge technology.

Further information is available at  
**[www.stilebertone.it](http://www.stilebertone.it)**

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