



APROSYS FINAL EVENT

Integrated Project on Advanced Protection Systems



Intelligent Safety Systems

Advanced side impact system for crash mitigation

Smart Material based reversible Crash Actuator

FUNCTIONALITY

- Selective door-seat locking
- Shifting of load paths
- Occupation of normally unavailable space
- Reversible, reusable safety system

EXPLOITATION

- market the SMA actuator
- use the knowledge gained about the application of shape memory alloys in a time critical automotive application in other products.

SOCIO-ECONOMIC IMPACT

A next big step in the reduction of severe and fatal road accidents is expected from a broad introduction of pre-crash protection systems.

TECHNICAL DESCRIPTION

Objective

Development of a smart reversible crash actuator that fulfils the protection strategy of establishing a new load path and reinforces the car structure to reduce the intrusion in survival areas.

The main requirements are:

- response time: < 200 ms
- reversibility (manually)
- gap to fill: 100 mm
- outer housing diameter: 40 mm
- max. load in direction of the bolt: 75 kN
- mountable inside the seat frame
- locking in end-position
- communication with the sensor system via CAN-bus
- compatibility to on-board power supply (12 Volts)

Approach

The requirements led to the idea of a combination of two actuator mechanisms. The first one is a “rotating beam” that is installed inside the door to close the gap between the outer and inner sheet metal of the door. Initially the beam is in an upright position near the sheet metal, which provides sufficient space for the motion of the glass pane. In crash case a specific CAN signal is received by the actuator electronics and both shape memory alloy mechanisms are activated.

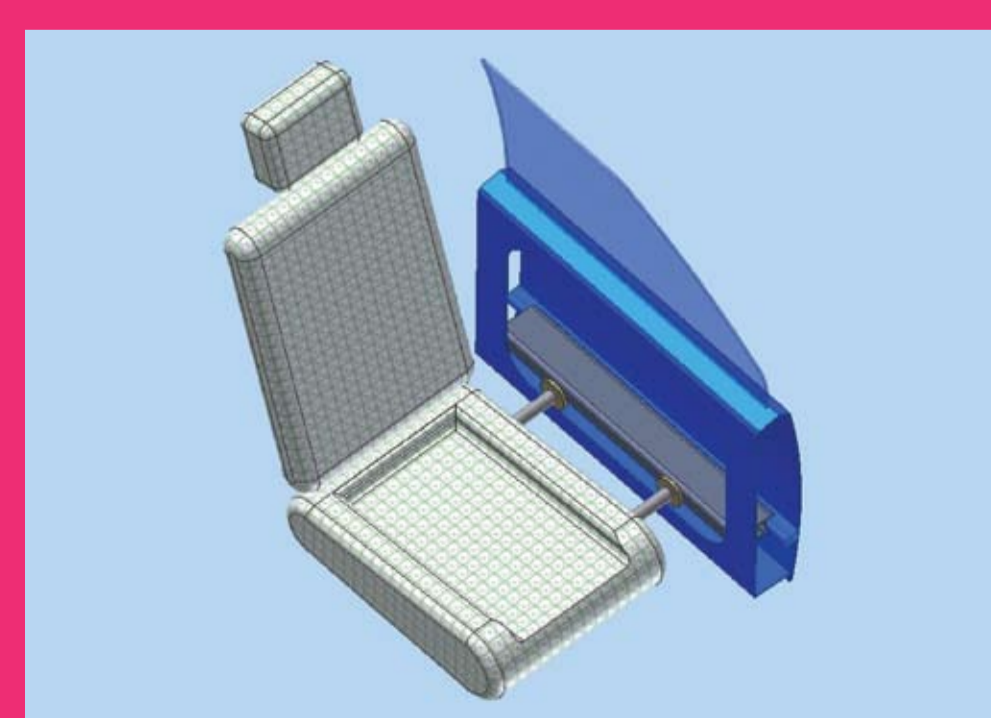


Figure 1: Seat with integrated tube actuator and door with rotatable beam.

The beam rotates and fills the gap between the outside and inside of the door. Figure 2 shows a schematic drawing of the “rotating beam”. A prestressed steel-torsion-spring (4) is mounted inside the beam. The spring is held by a clamp (2), which will be released by a shape memory alloy wire (1), if an activation signal is received. In this case the beam (5) rotates around a joint (3) and the counterpart for the tube actuator (9) switches into right position. In case of a positive false alarm, the rotated beam returns into its initial position driven by a second shape memory alloy wire (6).

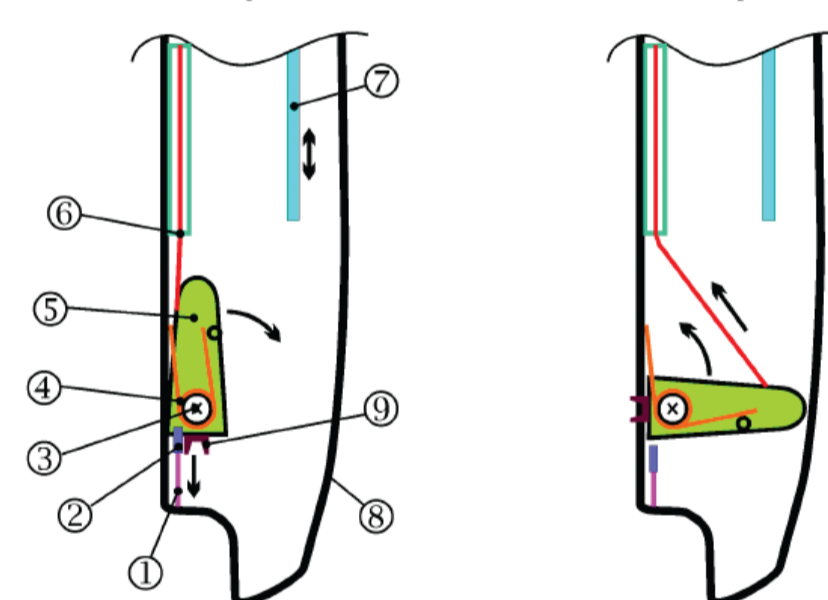


Figure 2: Schematic rotating beam

The second actuator is called “tube actuator”, as it is mounted inside a tube of the seat frame. The actuator consists of an active bolt that pops out of the tube towards the door trim and locks in its end-position, where it connects the inner door metal sheet and the seat frame. Figure 3 shows a schematic drawing of the “tube actuator”. A bolt (1), which normally rests in a housing, can be driven by a pre-stressed steel-spring (3) from its initial position (inside the seat frame) to a working position. At this working position the top of the bolt is guided by a counterpart at the door trim (4).

Small moveable radially mounted elements (2) lock the bolt and prevent an unhindered backward motion. As a result an additional load path is created to transfer the crash forces to the non-impact side.

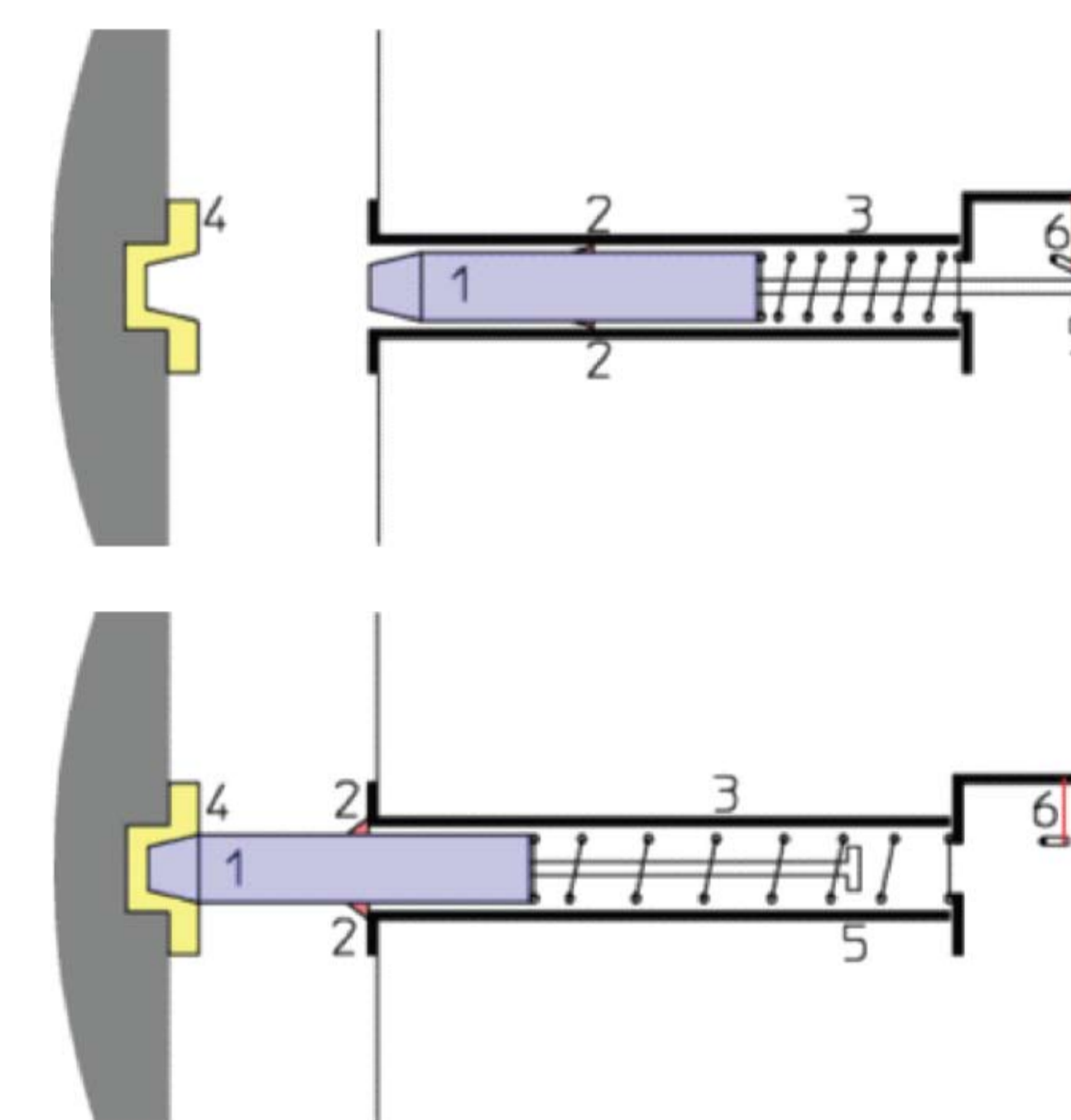


Figure 3: Functional principle of tube actuator (top: undeployed; bottom: deployed)

Conclusions

Some milliseconds before the crash happens, small release elements of a shape memory alloy (SMA) can be thermally activated to initiate the linear movement of a bolt and the rotation of a beam. By these measures it is possible to close existing gaps and selectively connect the door structure with the seat frame. Thus the crash energy can be directed to normally uninvolved areas of the car structure via different new load paths.

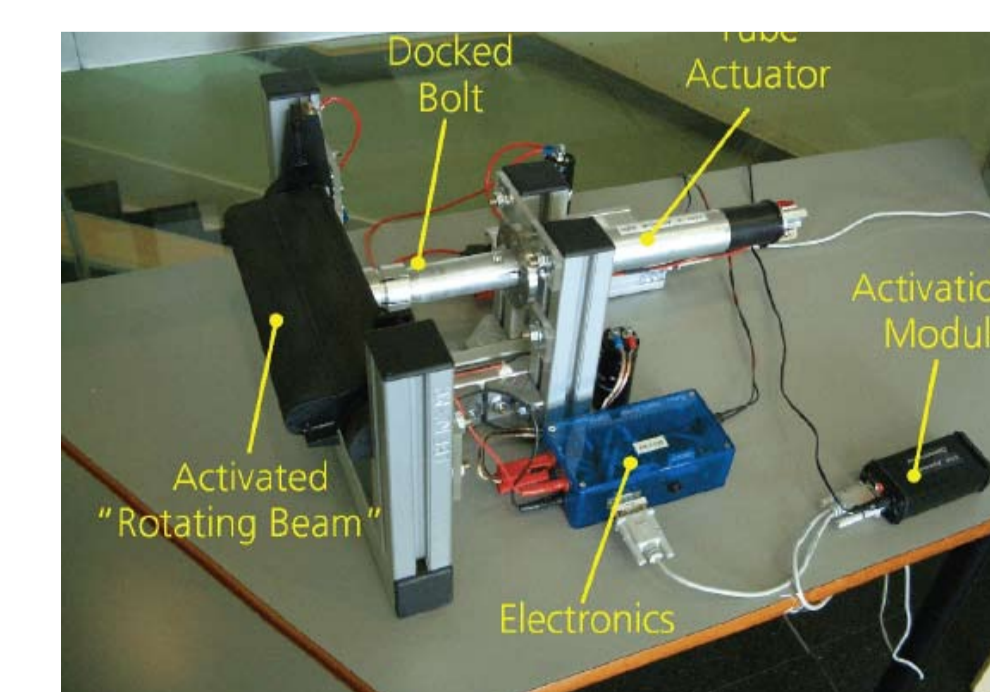


Figure 4: Functional demonstrator

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