

SwissTrolley+ – A Battery-Assisted Trolley Bus

The project SwissTrolley+ represents the motivation of research at universities and expert knowledge of industry to create a new product for public transportation. The resulting vehicle is a battery-assisted trolley bus that is able to overcome the disadvantages of conventional trolley buses and pure battery-powered vehicles. The innovative propulsion system of the trolley bus combines the key advantages of

both standard technologies. By using the high-performance traction battery, the bus is able to drive for distances of up to few kilometers without being connected to the overhead wires. This additional freedom allows the local public transportation operator to reduce the acquisition and maintenance costs for the overhead wire network and improve the comfort and service for the passengers.

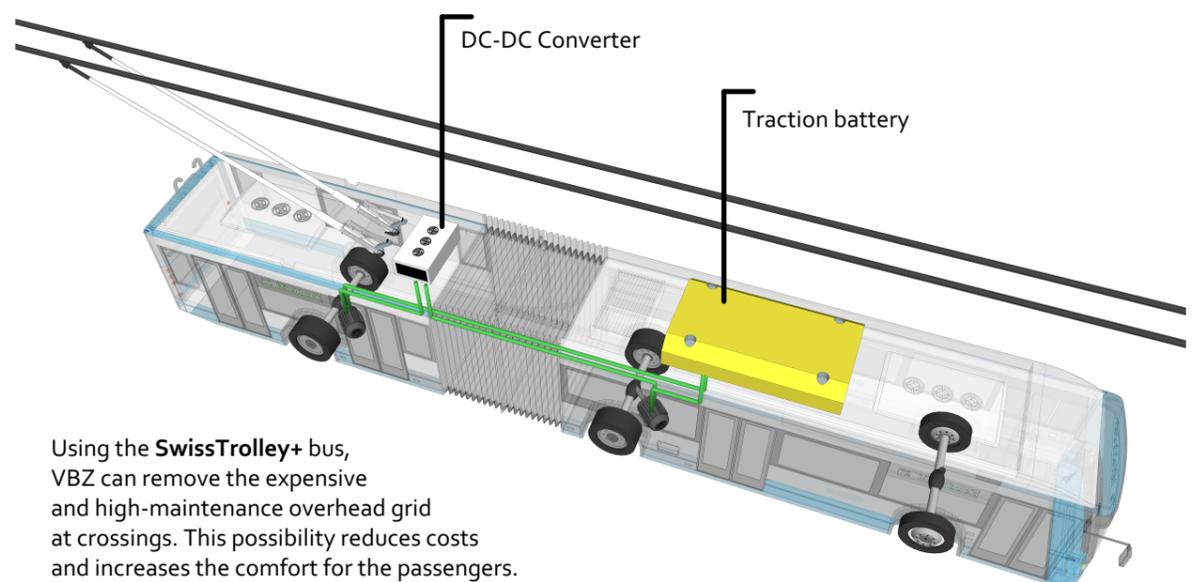
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Motivation

Trolley buses outperform engine-driven vehicles in many aspects. Electric machines are more efficient, have a higher power and torque density, allow to regenerate energy, they need less maintenance and are more reliable at the same time, and produce little noise and virtually no emissions. The only drawback is the need to be always connected to an electric grid. The SwissTrolley+ bus avoids this limitation by using a high-power traction battery. The resulting hybrid trolley bus is able to drive for short distances without the energy supply of the grid, which allows to remove the expensive grid infrastructure at crossings. Furthermore, the bus lines may be extended beyond the grid in order to serve new bus stops close to the existing lines.



Using the **SwissTrolley+** bus, VBZ can remove the expensive and high-maintenance overhead grid at crossings. This possibility reduces costs and increases the comfort for the passengers.

Goals & Challenges

The SwissTrolley+ bus has two sources of power: the electricity grid, and the traction battery. During operation, the energy demand is mainly defined by the driver. The two power sources, however, provide a new degree of freedom: in each moment of time, the energy management system of the vehicle needs to decide whether to draw electric power from the grid, or from the battery. To solve the decision of how to “split” the power demand between power sources, expertise in control systems theory is necessary. Thus, the development of the energy management strategy is being conducted in close collaboration with the control systems experts of ETH Zürich.

Albisriederplatz, Now and Then

Using the concept of SwissTrolley+, the overhead wire network can be removed without affecting the maneuverability.



Sources: (t) P. Elbert, (b) Youtube channel elektrische.com

Expected Impact

This project is a collaboration with the industrial partners Carrosserie HESS AG and VBZ. Together, the new vehicle type is developed, implemented, and run on Zurich's public transportation network as a demonstrator project. Due to the flexible architecture of the vehicle's software, the researcher at ETH and BFH can continuously improve the energy management strategy and the battery health control, respectively, and test the new algorithms on the SwissTrolley+ bus in real operation. Finally, this project allows to conduct a lot of interesting studies that aim towards the energy strategy 2050 of the Swiss government. A first simulation study [1] has shown that using battery-assisted trolley buses can result in energy savings of up to 20 %.

References

- [1] A. Ritter, P. Elbert, and C. Onder, “Energy Saving Potential of a Battery-Assisted Fleet of Trolley Buses,” presented at the 8th IFAC Symposium on Advances in Automotive Control AAC, Norrköping, Sweden, 2016, vol. 49, no. 11, pp. 377–384.

Partners