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Design of a dynamic and adaptive head support

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Introduction

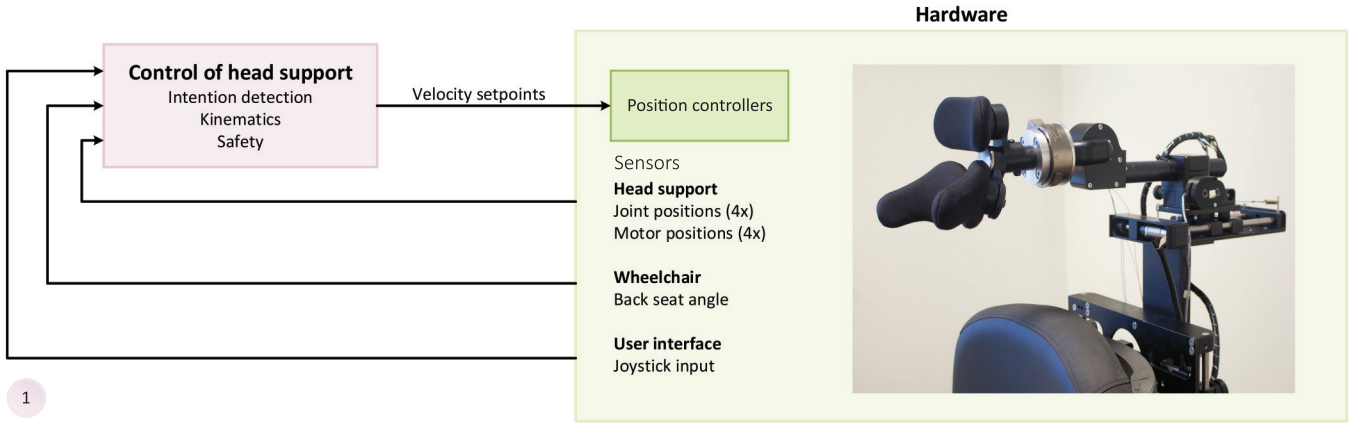
Advancements in the design of wheelchairs will allow the user to adapt their posture more easily for a certain activity, social situation or comfort [1]. To ensure proper support of the head, it is of high importance to adapt the position of the head accordingly [2].

Although several assistive devices exist that can support a person's head position, there is an absence of devices that are capable to support head movements in a natural and safe way. Changes in position of the trunk and head need to be combined with continuous stabilization, taking into acount the large individual variation between users.

Development of prototype

Within the Symbionics research project, a proof-of-concept of a dynamic and adaptive head support has been developed. Position control was implemented on an actuated head support system with four degrees of freedom (DOF), using a force sensor as joystick interface.

Manipulation of the joystick results in the head support repositioning according the flexion-extension motion of the head. Additionally, the system can autonomously adapt the head support position to the back seat angle of the electric wheelchair in order to compensate for changes in posture caused by changing seat settings.



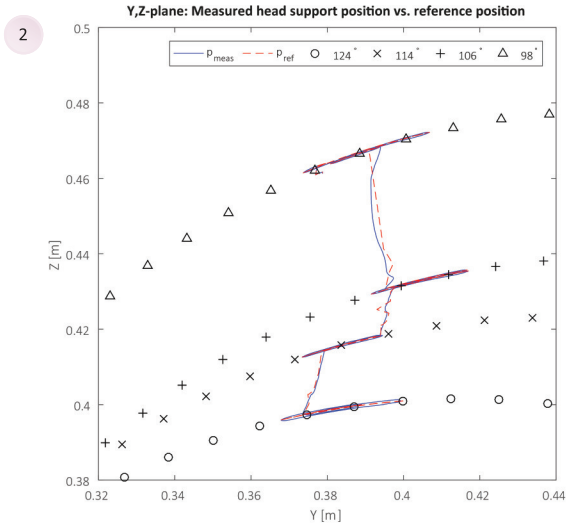


Figure 1 (top): Schematic overview of control implemented in prototype. Sensor inputs for head support position, back seat angle and joystick input are combined to calculate the velocity setpoints for the different DOFs,
Figure 2 (right): Measured head support position p_{meas} versus reference position p_{ref} for a selection of back seat angles. The flexion-extension curve is changed accordingly (indicated by the symbols).

Conclusions

Initial functional testing shows that the developed prototype matches the majority of the requirements set in the project design phase. Compared to current solutions, the presented system can steer the head support position in 3D in a more efficient and natural way. Further development is advised with respect to range of motion, robustness and user interface.

Acknowledgements

SYMBIONICS
MANIPULATION • BODY SUPPORT • FORM ADAPTATION

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