

## 16-848: Reference list for Monday, January 27<sup>th</sup>

The primary reference for today is:

Grebenstein, Markus, Maxime Chalon, Werner Friedl, Sami Haddadin, Thomas Wimböck, Gerd Hirzinger, and Roland Siegwart. "The hand of the DLR hand arm system: Designed for interaction." *The International Journal of Robotics Research* 31, no. 13 (2012): 1531-1555.

[https://journals.sagepub.com/doi/abs/10.1177/0278364912459209?casa\\_token=YNJ-](https://journals.sagepub.com/doi/abs/10.1177/0278364912459209?casa_token=YNJ-)

[jZvdFBcAAAAA:1z83KeA1qUFzzNnXvhgUFWnK\\_rTTAhP90aYfjpBJxSvQUnpGncSTDVgrkavwQzNEB1wxu3OXOjv5UA](https://journals.sagepub.com/doi/abs/10.1177/0278364912459209?casa_token=YNJ-jZvdFBcAAAAA:1z83KeA1qUFzzNnXvhgUFWnK_rTTAhP90aYfjpBJxSvQUnpGncSTDVgrkavwQzNEB1wxu3OXOjv5UA)

<https://www.youtube.com/watch?v=JVdufPRK4NI>

<https://www.youtube.com/watch?v=hSEnq7V8-mk>

[https://www.youtube.com/watch?v=TqvW\\_6PmBIA](https://www.youtube.com/watch?v=TqvW_6PmBIA)

The complete design of the hand of the DLR hand arm system (also known as David's hand or the Awiwi hand) has been written up Markus Grebenstein's dissertation:

Grebenstein, Markus. "Approaching human performance." PhD diss., Ph. D. thesis, Springer, Zurich, 2012.

[https://elib.dlr.de/78735/1/diss\\_cover.pdf](https://elib.dlr.de/78735/1/diss_cover.pdf)

This article gives an informal history of the recent research trajectory in humanoid robots at DLR:

Ott, Christian, Alexander Dietrich, Daniel Leidner, Alexander Werner, Johannes Engelsberger, Bernd Henze, Sebastian Wolf et al. "From torque-controlled to intrinsically compliant humanoid robots." *Mechanical Engineering* 137, no. 06 (2015): S7-S11.

<https://asmedigitalcollection.asme.org/memagazineselect/article/137/06/S7/442608/From-Torque-Controlled-to-Intrinsically-Compliant>

.. and you can find all of the DLR hands with images, descriptions, and specifications on this website:

<https://www.dlr.de/rm/en/desktopdefault.aspx/tabid-9656/>

The Variable Impedance Actuators are well explained in this presentation:

Wolf, Sebastian. "Design of the DLR Hand Arm System: Benefit of Variable Impedance Actuators (VIA)." (2014).

[https://elib.dlr.de/93329/1/Wolf2014\\_VIA\\_PPRIME.pdf](https://elib.dlr.de/93329/1/Wolf2014_VIA_PPRIME.pdf)

.. and formally described in this paper:

Friedl, Werner, Maxime Chalon, Jens Reinecke, and Markus Grebenstein. "FAS A flexible antagonistic spring element for a high performance over." In *2011 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 1366-1372. IEEE, 2011.

<https://ieeexplore.ieee.org/abstract/document/6094569>

Recently the hand has been simplified for low cost grocery picking:

Friedl, Werner Anders, and Maximo A. Roa. "CLASH-a compliant sensorized hand for handling delicate objects." *Frontiers in Robotics and AI* 6 (2019): 138.

<https://www.frontiersin.org/articles/10.3389/frobt.2019.00138/full>

<https://www.youtube.com/watch?v=6sLet9blWdA>