A1
The DLR hand-arm system — an example of electromechanical actuation abilities

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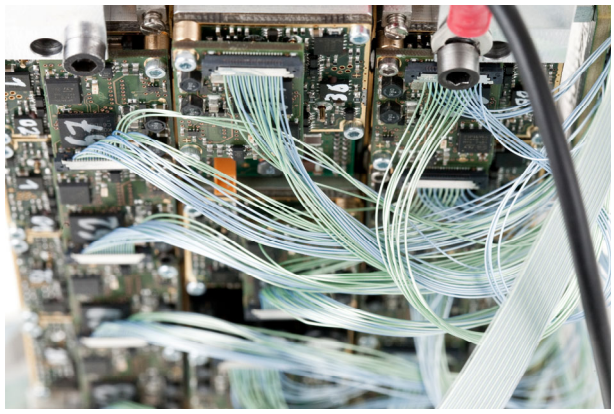
An anthropomorphic hand arm system using variable stiffness actuation has been developed which is aimed to reach its human archetype regarding size, weight and performance data [1]. The main focus is set to the dynamic performance and the robustness against impacts. Therefore, a paradigm change from impedance controlled mechanically stiff robots to robots using variable stiffness joints is done. Since contacts with rigid bodies introduce most of the energy into the system within the first control cycle, impedance controlled systems cannot withstand these without damage if the contact surface is stiff and the kinetic energy is high. In contrast, systems with passive compliance can store energy short-term and therefore reduce the resulting forces to the robot structure and drive train. Furthermore, it has been shown in direct comparison that variable stiffness joints are superior to stiff joints regarding their dynamic properties by measuring the maximum throwing range [2].

To reach this ambitious goal the selection of the appropiate drive principle is crucial. For DLR's hand-arm system, electromechanical actuation turned out to be the best solution regarding control characteristics, power density and even simplicity.

a)



b)

Figure - The DLR hand-arm system: a) anthropomorphic construction, b) control electronics.

[1] Grebenstein M, Smagt van der P (2008): Antagonism for a Highly Anthropomorphic HandArmSystem. Advanced Robotics (22), 39 - 55

[2] Wolf S, Hirzinger G (2008): A new variable stiffness design: Matching requirements of the next robot generation, 1741--1746

[3] Haddadin S, Albu-Schäffer A, Hirzinger G (2009): Requirements for Safe Robots: Measurements, Analysis & New Insights. Int. J. of Robotics Research