Novel Sensor Belt Connector for an EIT Device

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The company Swisstom AG is currently developing an electrical impedance tomography (EIT) heart-lung monitor. The goal of this master thesis was to improve its electrically unreliable connector, the SensorBeltConnector (SBC). The following requirements apply:
The single-use part "DockingStation" must have a durability of 50 connection cycles, despite its low-price requirement. The multi-use part "MatchBox" must endure 11'000 connection cycles. Contact resistances of the 14-pin SBC should remain smaller than 1 Ohm during the whole life span.

Materials and Methods

Multiple shortcomings of the initial SBC design were identified. Redesigning tasks were implemented in CAD for the DockingStation part as well as for the MatchBox part. Three prototypes with alternative designs were built and verified.

A test suite was developed to evaluate conformance of the final SBC prototype with the requirements. Fig. 1 shows the implemented mechatronic system, which allows repeated connection and disconnec-tion of the MatchBox from the DockingStation and measurement of the contact impedance. The control of the actuators and the impedance measurement system was realized by an Arduino microcontroller board. Impedance measurement data of the SBC contacts is transmitted to a host PC and processed in Matlab.

A sample size of 20 final DockingStation prototypes underwent contact quality tests on the test suite. 50 connection cycles, followed by 72 hours service life storage and again 50 connection cycles were performed. The contact impedances of each of the 14 pins were measured after each cycle. The MatchBox part was cycled in a durability test for 22'000 connections and disconnections while monitoring the contact impedances after each 100th cycle.

Results

Mean contact impedance remained below 0.25 Ω before and after the 72 hours service life storage (see Fig. 2). No disconnections could be detected on any contact of the test sample lot. Mechanical interlock of the MatchBox with the DockingStation remained fully functional after completion of the 22'000 cycles. The galvanic hard gold layer of the contact pads has remained intact. The rise of the mean impedance on the SBC contacts was minimal and remained below 10 mΩ during 1'000 connections and disconnections.

Discussion

Reliable functionality of the developed connector type has been successfully demonstrated on the implemented test suite. The contact quality and the durability requirements are met by the implemented SBC. Thus, the usage of the novel SBC can be recommended without any restrictions. The work done in this thesis substantially helps Swisstom to market a high quality product.

Acknowledgements

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Roger Infanger

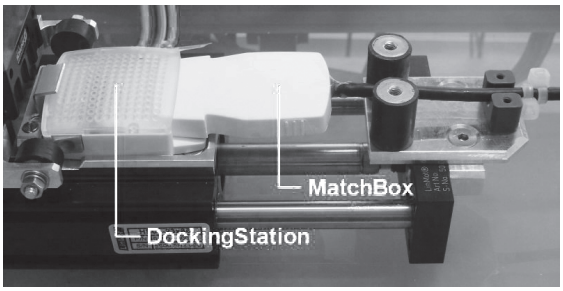

Fig. 1:
Test suite with DockingStation and MatchBox

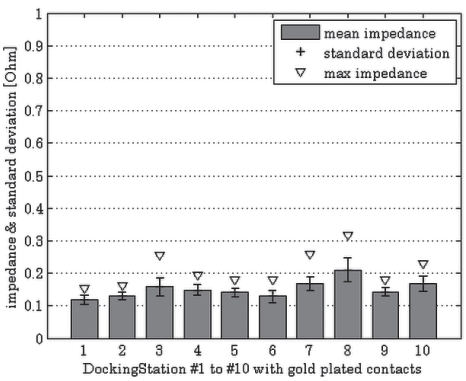

Fig. 2:
SBC contact impedance measurements of 10 DockingStations