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SmartSphincter RTD 2013

FNSNF

Electronics and Power Supply Implants for an Artificial Anal Sphincter

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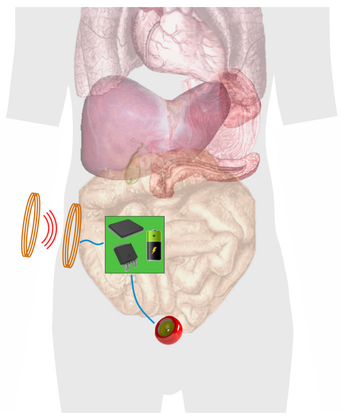
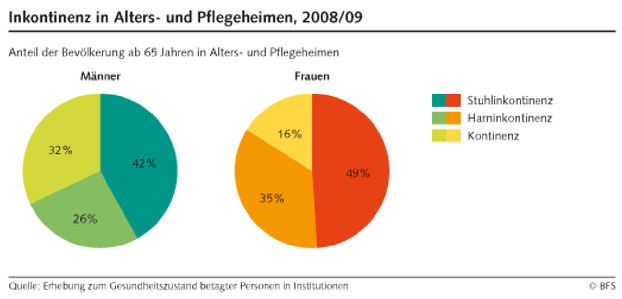
Introduction



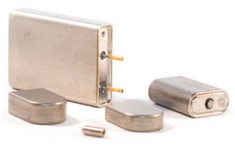
Disorder of continence is a common devastating physical disability often accompanied with social isolation (for Switzerland, see chart [1]).

The aim of this project is to develop an implant with the anal sphincter's functionality.



In-Body Power Supply

A rechargeable Li-Ion battery is implanted to power the sphincter. The battery can be recharged by a transcutaneous energy transfer (TET) system. Implantable FDA approved batteries with a few hundred mAh are available off the shelf (e. g. [2], right figure).



EAP Actuator	
EAP voltage	36 V
Work per cycle [3]	**658 mJ**
Recovered work per cycle	**0 mJ**
El. charge per cycle @ V_{Bat}	0.0635 mAh
# of Cycles per Day, n	**10**
El. charge for n cycles @ V_{Bat}	0.635 mAh

Consumption @ V_{Bat}	
EAP operation per day	0.635 mAh
Electronics operation per day	14.3 mAh
Electronics stand by per day	15.2 mAh
Total per day	**≈32 mAh**

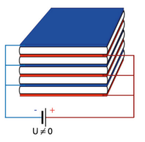
Battery	
voltage V_B	3.6 V
charge capacity Q_{Bat}	325 mAh
# of batteries	1

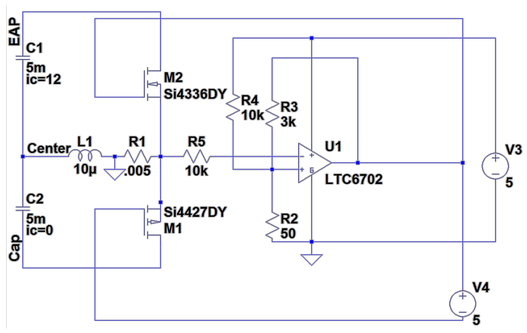
Discharging time	
charge per day	32 mAh
battery runtime	**10 days**

Charging time	
effective charging power	1.92 W
chargeing current @ V_B	0.52 A
charging time	**0.6 h**

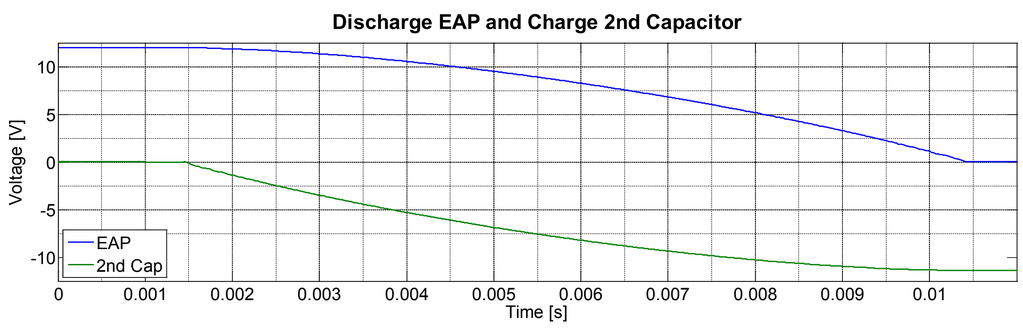
Actuator Driving and Energy Recovery

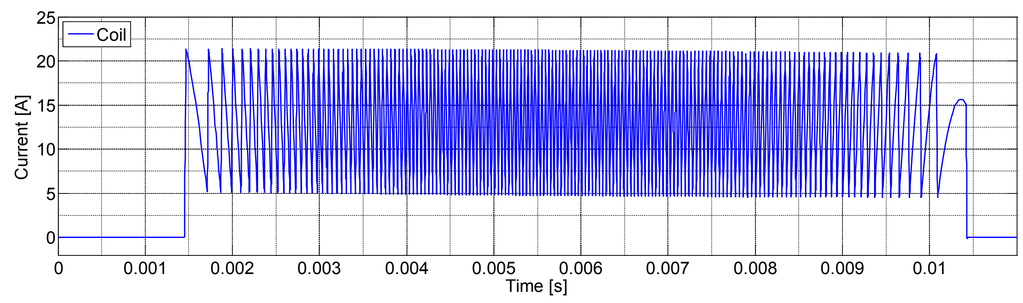
The actuator is a low voltage electro active polymer developed by the Biomaterials Science Center (BMC) of the University of Basel.



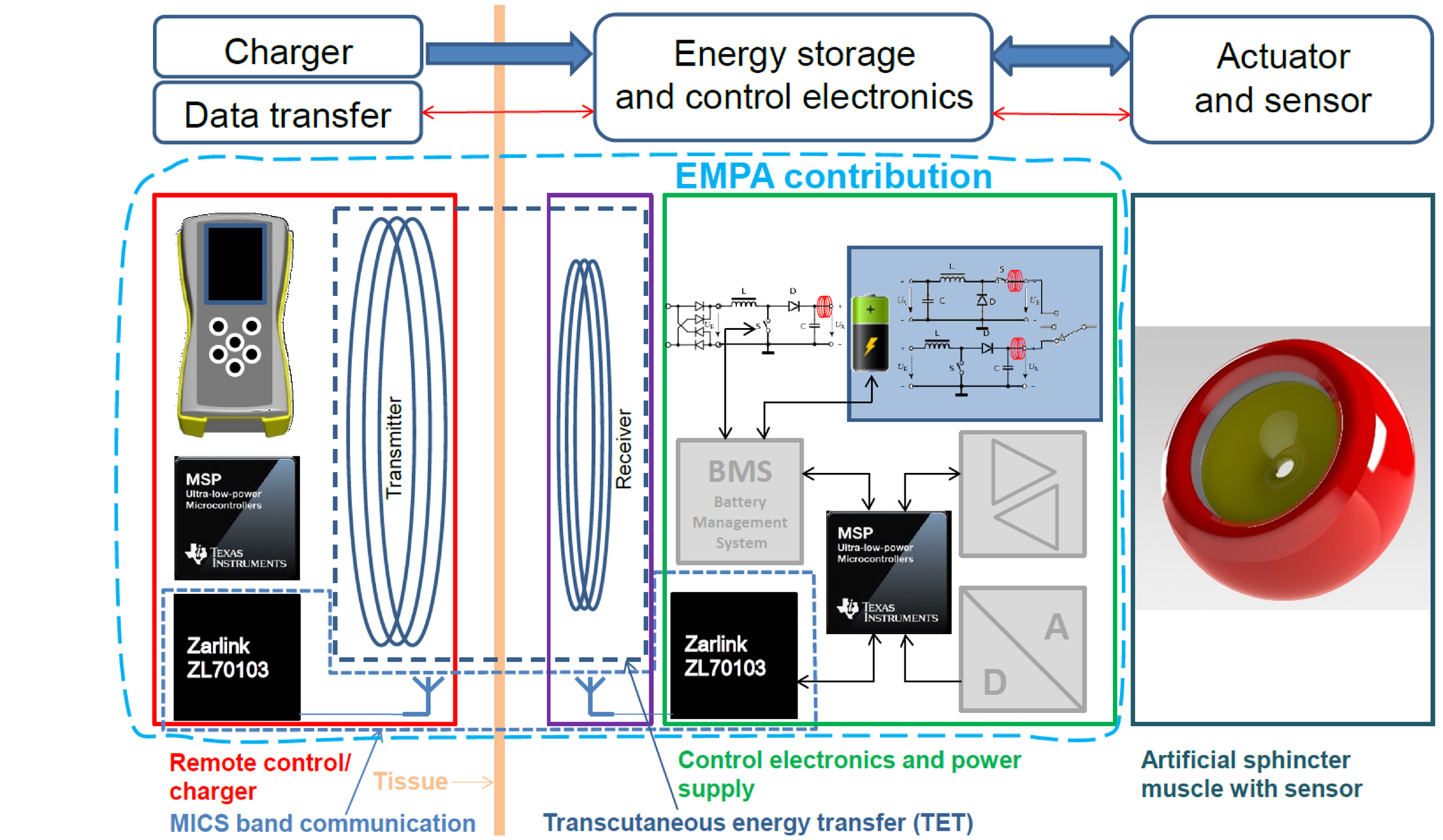


The actuator can be modeled as a capacitance. Driving electronics to charge and discharge the actuator was developed. A second capacitor is used to store the energy when discharging the sphincter.





System Overview



Reference:
[1] http://www.bfs.admin.ch/bfs/portal/de/index/themen/14/02/01/key/07/04.html, Bundesamt für Statistik, Neuchâtel (2008/09)
[2] http://www.eaglepicher.com/images/Medical/EaglePicher%20Medical%20Brochure%202010.pdf
[3] "Report on the experiment with Soft Anal Band (A.M.I.) cuff ", E. Fattorini, T. Brusa, (2014)

Acknowledgement:
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