# Wireless Power Transfer to High-Voltage Subcutaneous Implants using Near-Field Capacitive Coupling

Kush Agarwal (1, 2), Rangarajan Jegadeesan (2), Yong-Xin Guo (1), and Nitish V. Thakor (1, 2)
(1) Department of Electrical and Computer Engineering, National University of Singapore
(2) Singapore Institute for Neurotechnology (SINAPSE), Singapore

Modern neural implants use near-field resonant inductively coupled (NRIC) links for wireless power and telemetry. Being matched at an individual frequency, NRIC links easily tend to flex and detune post-implantation inside the curvilinear human tissue environment. Capacitively-coupled flexible patches, on the other hand, can conform and adapt according to the profile of the surrounding tissues.

Our recent studies in non-human primate (NHP) cadavers confirm that the power transfer efficiency (PTE) in near-field capacitively coupled (NCC) patches does not deteriorate significantly with the bending deformation (PTE >30% for stringent bending radius like 20 mm) [1]. Based on observations from our year-long chronic wireless implants inside NHPs using the NRIC scheme, and our validation of NCC scheme in the tissue models of NHPs, we propose and study the in-depth analysis and design process of an NCC powered high-voltage flexible implants. Effects like separation (tissue thickness) and linear misalignments, between the transmitter-receiver patches have been studied for PTE of the capacitively coupled link.

As an illustration for wirelessly powering high-voltage implant, a fully flexible NCC powered single channel tetanic muscle stimulator is designed and acutely tested in rats. To the best of our knowledge, this is the first demonstration of a wirelessly powered neural implant using the capacitive coupled powering scheme.

[1] R. Jegadeesan, K. Agarwal, Y. X. Guo, S. C. Yen, and N. V. Thakor, "Wireless power delivery to flexible subcutaneous implants using capacitive coupling," *IEEE Trans. Microw. Theory Tech.*, pp. 1–13, 2016. DOI:10.1109/TMTT.2016.2615623.