Niri, Rania. (2022). Deep Learning for Wound Image Analysis Applied to Diabetic Foot Ulcer Assessment. Diabetic Foot ulceration represents a major health problem all over the world leading to millions of lower limbs amputations every year. An early diagnosis and an accurate assessment are primordial to provide an efficient treatment and to prevent amputation. In recent years, healthcare professionals have shown great interest to imaging technologies. Considering the low-cost and prevalence of smartphones with a high-resolution camera, medical image analysis became an attractive option to help clinicians in the diagnosis process for a more accurate and objective assessment. On the other hand, after the success of deep learning in many real-world applications, it is widely implemented in the medical area to assist wound diagnosis due to its high efficiency and flexibility.

The main objective of this dissertation is to take advantage of the power of Deep Neural Networks and perform accurate wound assessment through medical image processing. To this end, we propose a novel smartphone-based system to evaluate the healing progress over time in an end-to-end style comprising automatic wound area extraction and tissue analysis. Six main tasks have been achieved in this study: (1) a wound database has been collected from collaborating hospitals, (2) an automatic wound labelling tool has been developed and made available to clinicians for a fast and effective tissue annotation, (3) a literature review of wound imaging methods using machine learning and deep learning techniques, (4) robust wound segmentation from challenging images acquired in clinical environment designed in two-stages dealing with both challenges data deficiency and complex backgrounds, the method was further improved to perform wound segmentation on the 3D mesh, (5) the integration of the wound segmentation methodology in a smartphones-based application, (6) the design of an end-to-end system for wound tissue classification combining superpixels segmentation and Deep Learning.

We obtained promising results that outperformed the state-of-the-art methods for both tasks wound segmentation and tissue classification. Hence, the complete assessment system has great potential to improve decision-making of healthcare professionals in wound care practice for all chronic wound types.

Keywords : Deep Learning, Fully Convolutional Neural Networks, 2D Segmentation, 3D Segmentation, Tissue Classification, Wound Assessment, Smartphone Images.