

Power Line Segmentation in Aerial Images Using Convolutional Neural Networks

Abstract. Visual inspection of transmission and distribution networks is often carried out by various electricity companies on a regular basis to maintain the reliability, availability, and sustainability of electricity supply. Till date the widely used technique for carrying out an inspection is done manually either using foot patrol and/or helicopter operated manually. However, recently due to the widespread use of quadcopters/UAVs powered by deep learning algorithms, there have been requirements to automate the visual inspection of the power lines. With this objective in mind, this paper presents an approach towards automatic autonomous vision-based power line segmentation in optical images captured by Unmanned Aerial Vehicle (UAV) using deep learning backbone for data analysis. Power line segmentation is often considered as a first step required for power line inspection. Different state-of-the-art semantic segmentation techniques available in the literature have been used and a comparative analysis has been done in terms of Jaccard index on two different power line databases. This paper also presents a new power line database captured using UAV along with the baseline results. Experimental results show that out of the four deep learning based segmentation architectures used in our experiments the Nested-UNet architecture out-performed others in terms of line segmentation accuracy in various background scenarios.

Keywords: UNet, Nested-UNet, Transfer learning, Unmanned Aerial Vehicle (UAV), Semantic segmentation, Power line inspection.

1 Introduction

Visual inspection of the transmission and distribution networks is often carried out by the electricity companies regularly to maintain the reliability, availability, and sustainability of electricity supply. Traditional methods used for inspection of power networks which are being followed from decades makes use of field surveys and airborne surveys [1]. Moreover, during emergency situations or on regular basis the inspection is usually carried out by a team of inspectors traveling either on foot or by helicopters to visually inspect the power lines with the help of binoculars and sometimes with Infrared (IR) and corona detection cameras [2]. The major limitation involved in using the above mentioned methodology is that the method is quite slow, it is expensive and involves danger and is also limited by the visual observation skill of the inspectors [3]. Therefore, in order to overcome these limitations of the traditional methods of power line inspection, recently a number of studies have been conducted to automate the visual inspection by using automated helicopters, flying robots, and/or climbing robots [3]. In this paper, we also propose a methodology for automatic inspection of the power lines in images captured by UAVs using Deep Learning (DL) as a backbone for carrying out the analysis.

