CHAPTER I
INTRODUCTION

Particle therapy refers to the medical application of ion beams, either protons or heavier ions, to treat individuals with either cancerous or noncancerous tumors. It is considered the most advanced type of radiotherapy. Although it may be slightly more expensive compared to traditional X-rays, ion beam therapy offers a great chance for significant advancements in the treatment and study of cancer. Over the past ten years, more than 20 clinical centers have been established in European countries, providing easier access to this cutting-edge therapy for European patients. Since 1952, over 190,000 patients have received proton therapy, while 28,000 have been treated with carbon ions (www.ptcog.ch). Currently, there are 80 proton therapy centers worldwide, about 30% of those located in Europe. The number of European proton therapy clinics is rapidly growing, with 15 operational facilities in 2017 and expected 31 proton therapy centers in clinical operation by the end of 2020 (Figure 1.1).

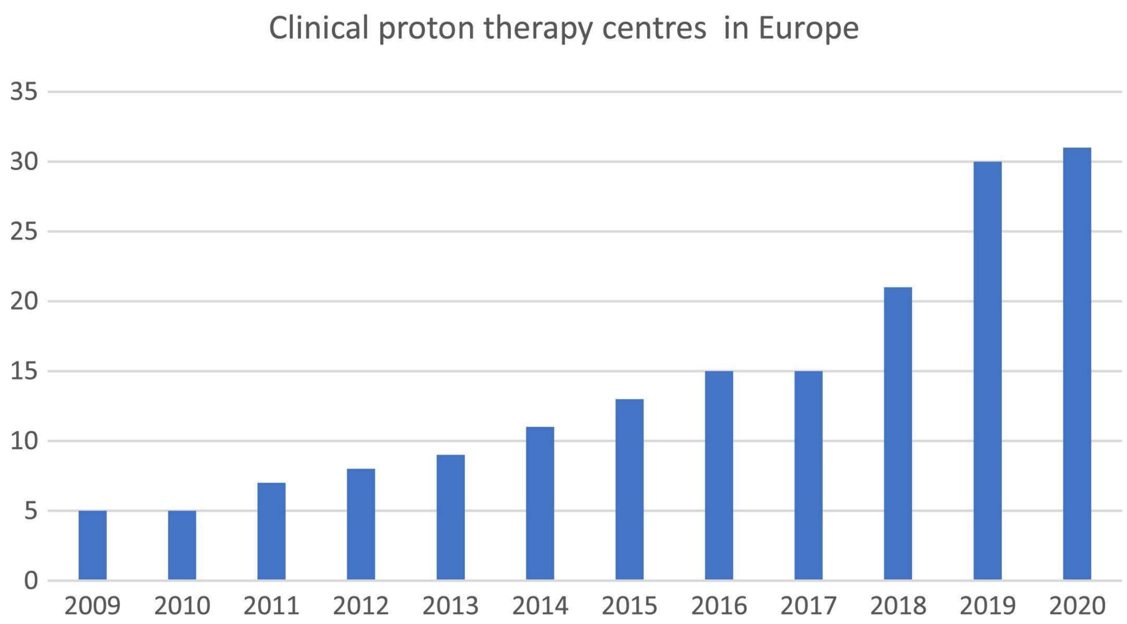

Figure 1.1 The number of clinical proton therapy centers in Europe 2009–2020. Source: www.ptcog.ch.

Proton therapy uses positive charged particles or protons to treat tumor cells. This has an advantage over using X-ray beam since it is possible to spare the surrounding tissues near the tumor cells due to the Bragg peak. X-ray Computed Tomography (CT) is still used in proton treatment centers to find tumor cells and figure out how much radiation to give. For the real treatment with a proton beam, the doctor and the medical physicist in charge of planning the treatment have to change the shape of the x-ray CT unit into the shape of the proton unit. This conversion causes uncertainty in the tumor position due to systematic errors. Using the proton beam for CT instead of X-ray can minimize this systematic error issue and help doctors to connect with the proton treatment planning by enabling tumor position verification directly (Schulte et al., 2005a). The solution of measuring and reconstructing the proton RSP distribution have been proposed with more precise in coversion technique (Schneider et al., 1996).

In 1976, Cormack and Koehler construct the prototype of Proton Computed Tomography (pCT) for testing at the Harvard Cyclotron Laboratory (Cormack and Koehler, 1976). A scintillator is mounted on a photomultiplier to detect residual energy from collimated proton beam at 158 MeV of energy. A two-dimensional (2D) tracking system can be included in the prototype to determine proton direction from the pre- and post-patient (Schulte et al., 2004).

The aim of this work is to develop a Monolithic Active Pixel Sensors (MAPS) telescope with proton beam at King Chulalongkorn Memorial Hospital (KCMH) to establish the position-sesitive detector (PSD) for pCT. Monte Carlo simulations and experimental data are used to reconstruct to be proton tracks. According to the high intensity of the operational beam, the number of protons from KCMH cyclotron source is reduced by collimator and Polymethyl Methacrylate (PMMA) degrader. The track following algorithm is applied to find the proton trajectory in 6 ALPIDE sensors as stacked layers. The result shows that the telescope can be constructed as tracker and MAPS telescope can be developed as part of a pCT prototype.