從水流星到洲際飛彈 導航科技發展史

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第六代行動通信 (6G) 發展低軌道衛星，最重要的應用是精準定位。在《黑暗騎士》(Dark Knight) 這部電影，蝙蝠俠為了追蹤「小丑」，將高登市所有手機的麥克風統通打開，監聽每一支手機附近的說話聲音，比對小丑的聲紋，並以手機定位，找到小丑的位置。這種做法顯然大闖紅燈，嚴重侵犯隱私權。在現實生活上，這種全面監聽已能實現。定位服務是科技演進的必然結果，無法抵擋的。

誰發明提供定位的 GPS ？主要的想法據說是來自於葛提 (Ivan Alexander Getting)，而由美國國防部花了 1,200 億美元建置。最初用來導航，而今日更顯著的用途是用來校正時間以及精準定位。例如過去的行動通訊基地台全都靠 GPS 來做時間的同步。第一套 GPS 系統包括了 18 顆衛星。這是當時擔任雷神公司 (Raytheon) 副總裁的葛提於 1951 年給美國空軍的建議，用以導航洲際飛彈 (ICBM)，使之能沿著火車鐵路路線移動。葛提亦活躍於學術界，於 1978 年擔任 IEEE 總裁。

另有一說，Roger L. Easton 才是「正港」的 GPS 之父。這種「誰是爸爸」的爭議，在科技界常常發生，我們也無法細究，只能在此平衡報導，以昭公信。

行動定位能精準神奇，是需要軟體配合的。前幾年有一則新聞，報導過年期間到苗栗大湖採草莓的人，大都飽嘗塞車之苦。警方懷疑是衛星導航惹的禍，因為衛星導航把駕駛人導引到距離最短、卻狹窄多彎的縣道一三〇線。苗栗警察分局雖在中山高三義交流道附近派了廿多名警員及義交指揮交通，但車潮還是一波接著一波，根本無力疏散。原本只需半個小時的車程，開了三、四個小時。

很顯然，衛星導航的程式智慧不足。抱怨的民眾最後下結論：「早知道就不要太相信衛星導航！」因此，導航軟體要寫好，才能充分發揮 GPS 的功能，否則仍然會「迷路」。關鍵在於人工智慧的預測要準。

早年沒有 GPS，只有靠大自然來定位。我的父親小時候住在雲林麥寮海邊，生活貧困。因為年紀太小，無法出海捕魚，冬天得跌跌撞撞跟著祖母到海邊，撿凍僵的死魚佐餐。冬天夜色來的早，潮水迅速上漲，如不及時上岸，就會淪為波臣。當黑幕快速籠罩大地後，無法分辨方向，只感覺黑暗、濕冷，及惶恐。此時祖母會依靠天狼星 (Sirus) 指引，將父親平安的帶回岸上。

台灣位於北迴歸線附近，冬季的傍晚，往東南方地平線的方向看去，最亮的那顆星，就是天狼星。天狼星是大犬座的第一亮星 (大犬座 α 星)。祖母沒有受過教育，不知道甚麼大犬座、天狼星，而是稱天狼星為很詩意的「水流星」(台語發音)。祖母說，由遠離岸邊的海中望去，低垂的天狼星如同在水面載浮載沉的漂流。

父親後來念書，才知道祖母口中的水流星，就是天狼星。湊巧的是，埃及人也稱呼天狼星為「水上星」。對父親而言，不管叫甚麼名字，天狼星不只是單純的方位導航，更是安撫惶恐，提供安全感的藉慰。今日我們有衛星定位，比起埃及人的天狼星，幸福多了。第六代行動通信的雙向定位加上人工智慧的預測，會冒出甚麼火花？令人期待。

From Water Meteor to Intercontinental Missiles, the History of Navigation Technology

As important complements to the sixth-generation mobile communications (6G) system, low-orbit satellites have provided initial navigation and precise positioning services. In the movie The Dark Knight, in order to track the villain Joker, Batman transformed the smartphones in Gotham City into a massive audio surveillance network, quietly enabling all citizens' microphones, scanning for the Joker's voice, and then finding the location of the Joker. This fictional approach represents a serious invasion of privacy, but it also alludes to the wealth of possibilities in our real world. From a technical perspective, tracking a person's every move has only become more achievable over the years. Afterall, positioning services are the inevitable product of technological evolution.

Who invented the GPS (Global Positioning System)? The idea was said to originate from Ivan Alexander Getting, an American physicist and electrical engineer, and the US Department of Defense spent $12 billion on its construction. Although the GPS was designed predominantly for navigation, it is gaining ground as a timing and precise positioning tool today. For example, all the mobile communication base stations relied on GPS for time synchronization in the past. The first GPS with 18 satellites was suggested by Getting in response to an Air Force requirement for a guidance system of a proposed intercontinental ballistic missile (ICBM) that would travel along a railroad system. Getting was also active in academia, serving as the president of IEEE in 1978.

On the other hand, some people consider Roger L. Easton as the "real" father of GPS. Arguments for "who is the father" often occur in the fields of science and technology. In most cases, it is impossible to say for sure, and we can only report the claims in a fair and balanced manner.

Mobile positioning calculates a person's precise position depending on software. A few years ago, a local news reported that most people who went to Miaoli Dahu for strawberry picking during Chinese New Year suffered through traffic jams. The police suspected that satellite navigation was the main cause of the traffic jam, because each car's satellite navigation guided its driver to the shortest, curved and narrow route—County Road 130. Although the Miaoli Police Station sent more than 20 police officers and voluntary traffic wardens to direct traffic near the congested Sanyi Interchange of Sun Yat-sen Freeway, with the continuous influx of vehicles in the area, drivers were unable to evacuate. As a result, a stretch of road that would have taken half an hour to drive through instead took three or four hours.

It is clear, then, that the satellite navigation software was not "smart" enough yet. People who complained at the situation finally concluded, "I would not have trusted satellite navigation if I had known that!" Therefore, the navigation software must be well written to fully utilize the functions of the GPS, otherwise it will still be "lost" in the routes. The key to effective use of the GPS lies in the accuracy of artificial intelligence predictions.

In the early days with no GPS navigation, pilots had to navigate by celestial signs. When my father was a child, he lived in poverty at the seaside of Mailiao in Yunlin county. He was too young to go fishing, but in the winters, he would follow my grandmother and stagger to the beach to collect frozen, dead fish for dinner. It gets dark earlier in the winter, and the tide rises rapidly. If you don't get ashore in time, you can easily drown to death. When darkness quickly enveloped the earth, my father was unable to find the direction to shore, and felt dark, clammy, and panicked. Yet each time, without fail, my grandmother would bring him safely back to shore with the guidance of Sirius.

The Tropic of Cancer crosses through Taiwan. On winter evenings, looking towards the southeast horizon, you will see Sirius as a vivid point in the sky. Sirius is the brightest star in Canis Major (CMa). My grandmother was uneducated and didn't know what "Sirius" meant, much less "Canis Major". Instead, she called Sirius by a very poetic name, "water meteor" (pronounced in Taiwanese). My grandmother said, when you looked at the sea far from the shore, the drooping Sirius seemed to float on the surface of the water.

After my father went to school, he learned that the "water meteor" named by my grandmother was more commonly known as Sirius. Coincidentally, the ancient Egyptians also called Sirius the Nile star, the forerunner of the inundation of the Nile. No matter what the name is, Sirius is not only a simple means of celestial navigation to my father, but also a comfort, a release from fear and a restoration of emotional safety. Today the satellite positioning system, which is more wonderful than the Egyptian's Sirius, provides much convenience to us. We look forward to seeing what sparks will emerge between the two-way positioning of the sixth-generation mobile communication system and artificial intelligence predictions.