Service robotics is becoming a reality in many aspects of daily life due to the successful merger of several enabling technologies from the fields of Information and Communication Technologies. The growing availability of mass market products is also driving innovation towards automation in several civil and scientific areas. The faster growth of the professional service robotics market the past half decade over industrial robotics is testament to the tremendous potential and impact envisioned of it in the upcoming years. To support such a new generation of service robots and vehicles, navigation capabilities play a fundamental role, whether be it in mission planning or on-field activities. Global Navigation Satellite Systems (GNSS) forms the navigational core in most outdoor applications and advancement in GNSS receivers in terms of complexity, processing capacity and cost adds to the capabilities of service robotics. However, development of GNSS algorithms in the context of Service Robotics specifically has been lacking, often solving problems through other sensors and technologies. GNSS positioning in harsh environments remain a challenge and the threat of RF GNSS interference has not been addressed in this field.

In this context, this thesis aims to maximize the input of GNSS technology in Service Robotics, developing robust and low cost GNSS receiver based solutions through available technological paradigms. Recent developments of ultra-low cost embedded GNSS smartphones provides this impetus to research into low cost navigation solutions. Modern smartphones also come with an advantage of having an ubiquitous network infrastructure with ease of developing interconnected applications and integrated proprioceptive and exteroceptive sensors, making it simpler to replicate automated unmanned ground vehicle and/or unmanned aerial vehicular networks of service robotics. Further, with the release of GNSS raw measurements in Android smartphones since Android 7, the opportunity of implementing collaborative solutions based on raw pseudorange processing for positioning and navigation is attractive in ready-to-network devices like smart-phones also considering the computational power of the current hardware setups.

The availability of GNSS raw measurements in Android smartphones allows in principle to improve the quality of GNSS-based positioning, by applying customized and advanced positioning algorithms. However, the quality of such measurements is poor, mainly because of the low quality of smartphones hardware components and the non-ideal environment in which phones are typically used. To overcome this problem and to separate the contribution of the hardware components and signals quality, dedicated test campaigns were carried out in a real environment and in a controlled environment anechoic chamber using different Android models. In addition, signal processing techniques aimed at increasing accuracy and precision of the solution were employed.

Cooperation between GNSS receivers is first explored through relative positioning via an iterative Least Squares approach, in order to detect fast changes in position and velocity of a GNSS receiver. Displacements and deformation phenomena are analyzed considering a single difference approach also differenced in time. Exchange of raw GNSS measurements are also applied on Android smartphones to retrieve the relative range between two such phones based on a collaborative technique. Additionally, a framework for the exchange of data between smartphones is provided, allowing the application of such a computationally-efficient ranging methodology in a network of low cost GNSS mobile devices. This work is further extended into a low-cost navigation strategy for a UGV-UAV paradigm by including the relative range in position computation.

Any interference threat to a GNSS receiver could have cascading effects at application levels and for interconnected systems. As a vulnerability assessment, experimental interference tests are performed on the navigational units of commercial UAVs and Android smartphones. Comparisons are seen between the two different GNSS receiver grade based units and possible metrics are identified to build a defense to such interferences. Finally, the potential aid to such a defense through Cooperative Positioning (CP) techniques in connected GNSS receiver networks is discussed.