

AI-enabled Integrated Sensing and Communications (ISAC) for Smart City and Intelligent Manufacturing

人工智能驅動的智慧城市和
智能製造通訊感知一體化 (ISAC) 技術

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Integrated Sensing and Communications (ISAC) refers to a technological approach that combines advanced sensing capabilities with wireless communication functionality, enabling enhanced situational awareness, real-time decision-making, and intelligent system integration. The AI-Enhanced ISAC technology is a pivotal enabler for the advancement of 5G and beyond communications, which optimises the utilisation of spatial, temporal, and frequency resources, resulting in an efficient and energy-efficient solution.

通訊感知一體化 (ISAC) 是一種結合先進感知能力與無線通訊功能的技術方法，能夠提升環境感知、即時決策和智能系統整合。人工智能增強的 ISAC 技術是推動 5G 及未來通訊發展的關鍵，它優化了空間、時間和頻率資源的利用，提供了高效且節能的解決方案。

The 5G networks provide the necessary high-bandwidth and low-latency connectivity to support the collection of vast amounts of data from various sensors. When combined with the decision-making and control capabilities of Artificial Intelligence (AI), this infrastructure can power emerging applications such as autonomous driving, telemedicine, and industrial automation. As the demand for urban perception functions accelerates with the growth of the low-altitude economy and smart transportation, the AI-enhanced ISAC network offers efficient and low-power solutions with significant market potential.

ASTRI has developed a range of ISAC technologies to address the evolving needs for the advancement of 5G and beyond communications. 應科院開發了一系列 ISAC 技術來滿足 5G 及未來通訊發展不斷演變的需求。

Hong Kong Applied Science and Technology Research Institute (ASTRI), leveraging its expertise in 5G, has developed a range of ISAC technologies to address these evolving needs:

1) ISAC Base Station Reference Design:

ASTRI's solution enhances the physical layer through resource sharing, channel model implementation, and target detection perception algorithms. By integrating AI capabilities, these ISAC base stations can unlock new opportunities for enhanced wireless connectivity, intelligent sensing, and the seamless convergence of communications and sensing applications, paving the way for innovative solutions in smart cities, transportation, and industrial automation.

2) ISAC Common Application Platform:

This is an integrated AI-based platform that brings new innovation opportunities to smart cities, industrial automation, transportation, and other domains. It enables the deep integration of sensing and communications functions, improving system performance and intelligence. The platform is compatible with Wi-Fi, Ultra-Wideband (UWB), and 5G wireless technologies, supporting applications such as child presence detection in vehicles and vehicle safety UWB digital key systems.

5G 網絡提供了必要的高頻寬和低延遲連接，以支援從各種感應器收集的大量數據。當與人工智能 (AI) 的決策和控制能力結合時，這個基礎設施可以為自動駕駛、遙距醫療和工業自動化等新興應用提供動力。隨著低空經濟和智慧交通的發展加速了對城市感知功能的需求，人工智能增強的 ISAC 網絡提供高效、低功耗的解決方案，市場發展潛力巨大。



香港應用科技研究院（應科院）憑藉其在 5G 領域的專業知識，開發了一系列 ISAC 技術來滿足這些不斷演變的需求：

1) ISAC 基站參考設計：

應科院的解決方案通過資源共享、通道模型實現和目標檢測感知演算法增強物理層。通過整合人工智能功能，這些 ISAC 基站可以為增強無線連接、智慧感知以及通訊和感知應用無縫融合開闢新機遇，為智慧城市、交通和工業自動化領域的創新解決方案奠定發展基礎。

2) ISAC 通用應用平台：

這是一個人工智慧的基礎綜合平台，為智慧城市、工業自動化、交通等領域帶來新的創新機會。它實現了感知和通訊功能的深度整合，提高了系統性能和智能化水平。該平台兼容 Wi-Fi、超寬頻 (UWB) 和 5G 無線技術，支援車輛中兒童存在偵測及車輛安全 UWB 數位鑰匙系統等應用。

3) 5G Cloud Robotics:

ASTRI's 5G Cloud Robotics solution combines physical machines with the power of 5G and Artificial Intelligence (AI) technologies to address the challenges posed by labour shortages, and the need for cost-effective, efficient robotic systems. The main features of ASTRI's 5G cloud robot include centimeter-level high-precision positioning for robot to move and work with extreme precision; enhanced computing power to process information and make decisions quickly and efficiently; simplified robot design with low cost; and reliable operation in dynamic environments. It provides companies with a powerful, precise, and reliable robotic solution that can help them streamline their operations and stay ahead of the curve as the workforce and technology continue to evolve.

ASTRI's 5G Cloud Robotics solution help company streamline their operations and stay ahead of the curve as the workforce and technology continue to evolve.

應科院的 5G 雲端機器人解決方案為企業精簡運營，並在勞動力和技術不斷發展的過程中保持領先地位。

4) Generative Pretrained Large Traffic Model for Multi-Modal Traffic Data Understanding:

ASTRI's ISAC is capable of efficiently capturing and integrating large amounts of heterogeneous traffic data from various sources. Leveraging this wealth of traffic data, ASTRI's generative pretrained large traffic model can perform data analysis to enable numerous smart mobility applications, such as anomaly detection, driver behaviour analysis, data-driven traffic simulation to support better planning and decision-making for transportation networks, and handling of rare and unseen cases, reducing the risks of accidents or congestion on roads.

ASTRI's ISAC support better planning and decision-making for transportation networks, reducing the risks of accidents or congestion on roads.

應科院的 ISAC 支持更好的交通網絡規劃和決策，從而降低道路事故或擁擠的風險。

In summary, as the integration of AI and ISAC technologies continues to evolve, it promises to unlock a wide range of innovative applications and solutions across various domains, from smart cities and autonomous vehicles to industrial automation and beyond. 🚀

3) 5G 雲端機器人：

應科院的 5G 雲端機器人解決方案將實體機器與 5G 和人工智能 (AI) 技術相結合，以應對勞動力短缺帶來的挑戰以及對具有成本效益、高效的機器人系統的需求。該機器人的主要特點包括：厘米級高精度定位，讓機器人能夠以極高的精度移動和工作；增強的運算能力，能快速高效地處理資訊並做出決策；簡化且低成本的機器人設計；以及在動態環境中可靠運作。該方案為企業提供了強大、精確和可靠的機器人解決方案，幫助他們精簡運營，並在勞動力和技術不斷發展的過程中保持領先地位。



4) 基於多模態交通數據理解的生成式預訓練交通大模型：

應科院的 ISAC 能夠有效地擷取和整合來自不同來源的大量異質交通數據。利用這些豐富的交通數據，應科院開發的生成式預訓練大型交通模型可以進行數據分析，實現眾多智慧出行應用，例如異常檢測、駕駛行為分析、數據驅動的模擬以支持更好的交通網絡規劃和決策，以及處理罕見和未遇過的情況，從而降低道路事故或擁擠的風險。



總括而言，隨著人工智能和 ISAC 技術的整合不斷發展，它有望在智慧城市、自主駕駛、工業自動化等各個領域開啟廣泛的創新應用和解決方案。 🚀