

## 台灣網路智能學會

### 106 學年度博碩士論文得獎名單

#### 博士論文獎 1名

論文題目：Mobile Small Cell Deployment in Wireless Communication Systems

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摘要：

One viable and low-cost method of accommodating the explosive growth of mobile broadband traffic is to introduce small cells for next generation cellular networks. However, static small cells cannot be flexibly placed to meet the demand of time/space-varying traffic, and idle or under-utilized cells would result in resource wastage and system performance degradation. Therefore, this dissertation adopts the mobile small cell concept and seeks to optimize the deployment of mobile small cells. If a finite number of mobile small cells can serve more users for more time, the mobile small cell deployment will have more gains. To reveal the performance gains from proper deployment strategies, this dissertation uses ground and airborne vehicles respectively to serve as the carriers for mobile small cells. We first target the deployment problem on the ground with the objective of maximizing the total service time of all users. Specifically, service time maximization exhibits an interesting trade-off between the user density and the travel time of mobile small cells. We prove that our target problem is NP-hard and cannot be approximated in polynomial time with a ratio better than  $(1 - 1/e)$ , unless  $P = NP$ . To solve the problem, we propose a polynomial time  $(1 - 1/e)$ -approximation algorithm, and the proposed algorithm is one of the best approximation algorithms based on the inapproximability ratio. Next, we extend our preliminary results on 2D deployment to further accommodate the flexible deployment of flying unmanned aerial vehicles (UAVs). As the residual battery capacity available to UAVs determines the lifetime of an airborne network, it is essential to account for the energy expenditure on various flying actions in a flight plan. The focus of this part is therefore on studying the 3D deployment problem for a swarm of UAVs, with the goal of maximizing the total throughput of all users. In particular, we address a thrilling trade-off among the flight altitude, the energy expense and the travel time. We formulate the problem as a non-convex non-linear optimization problem and propose an energy-aware 3D deployment algorithm to resolve it with the aid of Lagrangian dual relaxation, interior-point and subgradient projection methods. Afterwards, we prove the optimality of a special case derived from the convexification transformation. The capabilities of the above-mentioned proposed algorithms are evaluated by conducting a series of simulations with realistic parameter settings, providing insightful and encouraging results in mobile small cell deployment for wireless communication systems.

**關鍵字：**approximation algorithm, cellular networks, Lagrangian dual relaxation, maneuvering power, mobile small cell, non-convex non-linear optimization, small cell deployment, unmanned aerial vehicle (UAV).

## 碩士論文獎 4 名

論文題目：根據區間 Type-2 模糊集合以作群體決策及根據區間直覺模糊值以作多屬性決策之新方法

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摘要：

在本論文中，我們根據區間Type-2模糊集合提出一個新的群體決策方法且根據區間直覺模糊值提出一個新的多屬性決策方法。本論文中所提之第一個新方法是根據區間Type-2模糊集合、增強型Karnik-Mendel演算法、及有序加權平均運算子以作群體決策，其中決策者們所提供的評估矩陣及屬性權重向量都是以語義詞來描述的區間Type-2模糊集合來表示。我們所提之新方法能自動的修正各個決策者的權重，直到群體共識度大於或等於預定之門檻值，其可以克服目前已存的群體決策方法之缺點，並且提供我們一個很有用的方法以在區間Type-2模糊集的環境中作群體決策。本論文中所提之第二個新方法是根據區間直覺模糊值及根據雙曲線正切函數的非線性規劃方法以作多屬性決策。決策者提供的決策矩陣及屬性權重都是以區間直覺模糊值來表示。我們所提的新方法先建立決策矩陣的轉換決策矩陣，然後使用雙曲線正切函數構成的非線性規劃模型來得到各屬性的最佳權重，然後採用區間直覺模糊加權平均運算子以計算各方案間有加權評估區間直覺模糊值，最後再對所得之加權評估區間直覺模糊值進行比較以獲得方案間之偏好排序。本論文中所提之第二個新方法可以克服目前已存在之多屬性決策方法的缺點。

本論文總共發表四篇論文於SCI國際期刊及國際研討會中，其中有三篇論文發表於SCI國際期刊 *Information Sciences*，且有一篇論文發表於2018 *International Conference on Machine Learning and Cybernetics*，成果非常豐碩。

**關鍵字：**開放式車輛路徑問題、粒子群演算法、二元優化法、專制式決策、多屬性決策、多屬性群體決策、EKM演算法、區間Type-2模糊集合、OWA運算子、直覺模糊集合、區間直覺模糊值、非線性規劃法、雙曲線函數。

論文題目：基於特徵表示學習之異質性社群媒體項目興衰預測

學校：國立成功大學 統計所

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摘要：

隨著手機定位科技的完善以及社群媒體的興盛發展，基於地點位置的線上社交網路服務越來越多元且越來越受歡迎，諸多服務皆允許用戶分享生活經驗與位置訊息。而經由這些服務所記錄的資料量非常龐大，但若妥善運用其效益也相當可觀，如根據歷史的打卡記錄為用戶推薦可能感興趣的地點、根據歷史貼文的關注數量排序社群媒體網站的內容等。本研究擬提出一套研究方法預測地點的倒閉風險以及預測貼文的熱門程度。然而針對相關問題過去的研究多以擷取社群媒體事件相關的特徵，如用戶行為特徵、地理位置特徵等，需昂貴又費時的特徵標記工程，且其方法對特徵品質有一定的要求才能擁有好的預測表現，而本研究提出利用社群媒體事件時間序列建構圖形並學習特徵表示向量再結合容易擷取的特徵，此作法

避免擷取特徵時需耗費的時間與金錢成本以及分散擷取之特徵品質良莠不齊的風險。此外，我們透過貼文主題分析，延伸開發出一個人化自激點過程時間序列預測模型，可有效與學習而得之特徵表示向量結合，用以預測未來時間序列。本研究以透過約1,900萬筆Instagram 打卡數據與約52,000 筆Foursquare 有標記之地點，以及約166,000 筆Twitter 貼文分享數據進行系統性實驗評估，結果顯示相比於傳統特徵擷取，我們藉由特徵表示學習所產生之特徵向量，在地點倒閉風險評估與貼文熱門程度預測上，皆有非常顯著之準確率提升，不同設定下準確率與誤差分別至少提升10% 與降低10%。本研究具體貢獻有三，(1) 我們所提出的特徵表示學習方法可非常有效地將時間序列轉為特徵向量，可廣泛應用於時間序列資料之分類問題上；(2) 我們的預測方法可準確預測出在未來倒閉風險較高的地點，提供商家作為行銷規劃之評估，政府單位亦可監控各地區經濟消費狀況；(3) 我們的預測方法可準確預測社群媒體上貼文熱門程度的未來趨勢，可應用於社群網路病毒式行銷。

**關鍵字：**社群網路分析, 特徵表示學習, 倒閉風險評估, 自激點過程。

論文題目： An Embedding Learning-based Approach to Predict Influencers for Location Promotion in Social Networks

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摘要：

Users in online social media tend to share their life via social networks and location checkin actions. Thus Location-based Social Network (LBSN) data can be formed accordingly. While LBSN has been exploited for applications such as Point-of-Interest (PoI) recommendation and social link prediction, an emerging task is Location Promotion, i.e., finding opinion leaders to promote a sepcific PoI. In this work, we propose and tackle two novel tasks, Targeted Influencer Prediction (TIP) and Targeted Visitor Prediction (TVP), in the context of Location Promotion. Given a target POI  $l$  to be promoted, TIP aims at predicting a set of influential users who can attract more users to visit  $l$  in the future, while TVP is to find a set of potential users who will visit  $l$  in the future. To deal with TIP and TVP, we propose a novel graph embedding method, LBSN2vec. The main idea of LBSN2vec is to learn a lowdimensional feature representation for each user and each location in an LBSN. In order to effectively find the reasonable context of each node for LBSN2vec, we devise a new weighted and penalized random walk mechanism. Equipped with the learned embedding vectors, we propose two similarity-based measures, Attractiveness and Visiting scores, to predict the influencers and potential visitors. Experiments conducted on a large-scale Instagram LBSN dataset exhibit that LBSN2vec and its variant can significantly outperform state-of-the-art graph embedding methods in bot h tasks of TIP and TVP.

**關鍵字：** Graph embedding, Feature learning, Information networks

論文題目： Secure Hierarchical Bitcoin Wallet Scheme Against Privilege Escalation Attacks

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摘要：

As the rising popularity of Bitcoin, people tend to use Bitcoin wallets to managing the keys for spending or receiving funds. Instead of generating pairs of keys randomly which are hard to be stored, hierarchical deterministic (HD) wallets derive all the keys from a single seed, thus storing that seed is sufficient to recover keys. In an HD wallet, it allows users to generate child public keys from parent public keys without knowledge of any private key. A suitable case for this feature is that an auditor is permitted to derive all the public keys for auditing. However, this impressive feature makes HD wallets suffered from so-called privilege escalation attacks that the leakage of any one of child private key along with its parent public key will cause the exposure of the other child private keys.

To confront with this severe problem, we propose a novel HD wallet scheme that gives out a signature with trapdoor hash functions instead of directly giving anyone private keys for signing. Since it conceals private keys from any child nodes, it can prevent from privilege escalation attacks. Nevertheless, the proposed scheme also provides unlinkability between two public keys in order to achieve anonymity of user identity and high scalability to the derivations of keys. Thus, the proposed scheme achieves user anonymity, public key derivation and high scalability.

**關鍵字：** Bitcoin, HD wallets, BIP032, Privilege escalation attacks, Schnorr signature, Trapdoor hash function