一個解決TSP問題最佳解的穩定方法-以TA演算法為例

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摘 要

在最佳化問題（OPTIMIZATION PROBLEMS）的求解中，全區域最佳解通常是很難求得的。而旅行推銷員 問題（TRAVELING SALESMAN PROBLEM）是最佳化問題中一個相當典型的例子。在系統規模小的時候，模 擬退火（SIMULATED ANNEALING）在求最佳解上是一個相當有效率的方法，但是當系統規模變大的時候， 模擬退火法求解的時間將大幅增加，以致於無法在合理的時間內求得最佳解；或是在退火的過程中，因 無法跳脫陷入局部最佳解的陷阱，因而接受了其他的劣化解（區域最佳解）。 因此，我們採用門檻接受法（THRESHOLD ACCEPTING；TA）具有避免陷入區域最佳解的特性，使得整 個求解過程的運算時間縮短，及大幅降低陷入區域解的機率。更者為了能使確保每次運算的結果皆能達 到最佳解的穩定收斂狀態，我們在此提出了雙重門檻接受（DOUBLE TA）演算法。而經運算所得的結果 亦顯示出，在TA中若能選擇適當的門檻植，其所得最佳解之值確實較優於別種解法。在此門檻值被分為 二個部分：標準化門檻值（NORMALIZED THRESHOLD VALUES）和上限值（CAP）。門檻值等於標準化門檻 值乘以上限值。 我們利用一條經標準化並由數個控制節點所構成的自然雲形線（NATURAL CUBIC SPLINE）來決定門檻 值。我們使用MATLAB程式語言發展出一動態插入點的GUI（GRAPHICAL USER INTERFACE）介面，讓使用者 能夠自由的輸入所需的控制點，以達到所想要的門檻值模型。而上限值我們採用B. HAJEK所提出的第二 最小值深度的觀念，使得CAP值越小越好，並且能夠穩定的達到最佳解。 首先，我們將嘗試用雙重TA演算法，求出傳統的對稱性方格矩陣（REGULAR-GRID TSP）問題，城市（ 或稱節點（NODE））數目從16到441，每個例子運算100次，試圖達到每次皆能有最佳解的產生。其中我們亦想要解決GROTSCHEL的PCB442問題，這個問題在文獻上是個頂難的問題。以上所有程式都是用BORLA -ND C++程式語言來撰寫。 這裡我們所提出的雙重TA演算法，指的是在一次完整的最佳化運算過程中將門檻接受法執行兩次，而第二次的執行，其目的為的是以防第一次運算的過程會有非達最佳化結果的產生。

關鍵詞 : 旅行推銷員問題、模擬退火、門檻接受法、標準化門檻值、上限值、自然雲形線

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