講座大師伍法岳（Fa-Yueh Wu）演講與對談一

網路中的電阻問題

Two-point Resistances in a Resistor network

綱要：

電路學中一個著名的經典問題，是如何計算網路中任何兩點間的電阻，這是一般普通物理課程中均討論到的課題。電阻之並聯、串聯，以及三點相聯的計算甚為簡單，但在實際應用中，例如一個 5 × 4 電阻為 r 的晶格中，(0,0 ）與（ 3,3 ）兩點間的電阻R ，其計算即甚為複雜。

在這個課程中，我們用與網路相關的 Laplacian 矩陣來考慮此一問題。Laplacian 矩陣為克希荷夫（Kirchhoff）氏一百五十餘年前所提出，與圖論中的 spanning tree 有關，在我的"排列組合與統計物理"課程介紹中，亦有涉及。我們導出的結果是任何兩點間的電阻可用矩陣的本徵值與本徵向量來表示。用於上述 5 × 4 晶格的問題，我們求得答案為：R = (2,356,898/1,380,027)r = (1.708..)r.

A classic problem in electric circuit theory discussed in every elementary physics textbook is the computation of resistance between two node points in a resistor network. The rules of combining resistors in parallel and series as well as with three-point connections are well-known. But in real applications the use of these rules can become extremely tedious such as in, for example, the calculation of the resistance R between two nodes (0,0) and (3,3) in a 5x4 rectangular array of resistors r.

In this talk we present a formulation of two-point resistances in a resistor network in terms of the eigenvalues and eigenvectors of a Laplacian matrix associated with the network. The Laplacian matrix, which was first introduced by Kirchhoff more than 150 years ago, also generates spanning trees on the network, a subject matter covered in my other talk "Combinatorics and statistical physics". This formulation of resistances, which applies to arbitrary resistor networks, deduces the answer to the aforementioned resistance problem as R = (2,356,898/1,380,027)r = (1.708..)r.

講座大師伍法岳（Fa-Yueh Wu）演講與對談二

排列組合與統計物理

Combinatorics and Statistical Physics

綱要：

排列組合是用來統計事件的一個數學領域，計算有多少種方式可將 32 個骨牌放在 8 x 8 的棋盤上便是一例。統計物理則是能解釋如氣體與固體等凝態性質的一門物理領域，近年來趨勢顯示要解決許多統計物理的問題需要在排列組合中發展新的數學方法，例如有三個物理學家就解決了棋盤問題，答案是 12,988,816 個方法，他們也找到任何 n x n 棋盤的解答。演講中我將討論一些統計物理未能解決的重要排列組合問題。

Combinatorics is the branch of mathematics which deals with the counting of events. A prime example of a combinatoric problem is the counting of the number of ways that an 8 x 8 chessboard can be covered by 32 dominoes. Statistical physics is the branch of physics which explains the properties of condensed matters such as gases and solids. In recent years it has become apparent that the solutions to a number of problems in statistical physics require the development of special mathematical method in combinatorics. It was 3 physicists, for example, who solved the chessboard problem to obtain the answer 12,988,816 and, in fact, the answer for any n x n board. In this talk I shall explore some of the exciting combinatoric problems arising in statistical physics including challenging unsolved ones.

Terms of translation: Dominoes (Ku Pi) , chessboard (Chi Pan)