電子連接器金屬彈片磨耗分析與驗證

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摘要

輸出/輸入型態電子連接器經過數萬次插入/拔出後，插拔力量通常因插拔次數增加而顯著下降，其主因之一係電子連接器內之金屬彈片磨耗所致。本研究以audio-jack電子連接器為檢視對象，其插拔力量下降至規範要求時，定義為疲勞失效。執行有限元素分析進行此類電子連接器內鎳銅/磷青銅合金彈片之耐久性評估，彈片材料假設為均向性，具備彈/塑性行為，與遵循均向性硬化法則。採用Archard磨耗法則計算金屬彈片之磨耗量，其值多寡係由金屬彈片與匹配公端子間之接觸壓力，滑移距離，與材料硬度等決定。撰寫使用者副程式UMESHMOTION搭配有限元素分析商用軟體ABAQUS，計算金屬彈片接觸面相關節點位移量，藉以獲致插拔力量與插拔循環週期之關係。藉由模擬結果與相對應實驗量測比對，驗證數值分析合宜性，據以評估其他設計/型態電子連接器於實際應用情形時之疲勞壽命。

關鍵字：電子連接器、磨耗、有限元素分析

ABSTRACT

It is commonly observed that the insertion/withdraw force of audio-jack type electronic connectors would decrease significantly under cyclic mating/unmating procedures. A major mechanism causing such phenomenon could be due to wear performed on the metallic terminal. In this study, fatigue failure of the connector is defined as the insertion/withdraw force dropping to the minimum requirements, and a finite element analysis is conducted to estimate the corresponding durability. Copper alloys with an assumption of isotropy are adopted for the terminal material. Elastic-plastic response and isotropic hardening rule are implemented into the analysis as well. The Archard wear model accounting for abrasions as a function of the contact pressure and the sliding distance as well is adopted here. A user subroutine UMESHMOTION integrated in the commercial package ABAQUS is coded to control the movement of the contact surfaces. Simulation results are then validated by the corresponding experimental measurements.

Keywords: electronic connectors, wear, finite element analysis