改良式合成噴射氣流器有限元素模型的建立和實驗量測與驗證

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摘 要

壓電陶瓷(PZT)為鋯鈦酸鉛(LEAD ZIRCONATE TITANATE)固溶液(SOLID-SOLUTION),於1954年由JAFFE等 人發現，其具有的優良壓電特性(PIEZOELECTRIC PROPERTIES)，壓電性質是一種機械能與電能交互作用 的現象。 壓電陶瓷的壓電特性包括正壓電效應與逆壓電效應兩種，正壓電效應係壓電陶瓷受到機械應力或應變 作用而使壓電陶瓷表面產生電荷,即是壓電感測器原理,例如：加速規與壓力感測器等。而逆壓電效應則 是以電能輸入壓電陶瓷使之產生機械能或位移的輸出,即是壓電致動器原理。 主動式氣流控制的應用上，一直存在著一個最大的問題，就是它現有的制動系統需要相當大的能量去 作動。因此一個高效率的主動式制動器在主動式氣流控制的應用上是不可或缺的要素。近幾年來，智慧 型材料和結構是一個具有相當潛力的新研究課題，其中智慧型材料製成的主動式制動器也是一項重要的 研發領域。制動器的元件包括有記憶合金(SMA)、壓電片(PZT)、電流變液(ER FLUID)和磁流變液(MR FL -UID)等。其中以壓電材料作動的合成氣流噴射器(SYNTHETIC JET ACTUATOR)經許多研究學者驗證在主 動式氣流控制方面展現出良好的控制效率和大量的潛在應用。 計劃的主要目的是建立一個壓電式合成噴射氣流器的有限元素模型，然後應用此模型做性能分析與朝 著輕量化、提高效率等方面去做改良。這個模型包括:壓電片中的結構/電場/流場的偶合性質、複合材料 結構的特性。藉由這個模型去分析、探討壓電式合成噴射氣流器的最佳化設計—希望找到以最小的電壓 輸入，產生最大的位移變形量或作用力時其幾何結構和材料，然後用分析中所發展的最佳化技術去改進 壓電式合成噴射氣流器，並測試新致動器的性能，與現今商業生產的THUNDER作一比較。

關鍵詞 : THUNDER、壓電致動器、有限元素法、主動式氣流控制。

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