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Time and Frequency Response Analysis
Test Platform for Woodwind Reed

木管樂器簧片時域與頻域響應分析測
試系統



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作品摘要

合作廠商設計研發合成簧片，為確保產品的頻率、音色有國際大廠的水準，能進入高單價的國際市場，委由本實驗室協助開發具有可視化的時域波形及聲學的圖形化頻譜；可視化界面提供了更多的信息，可以幫助製造商直接瞭解合成簧片的品質。另外，時域響應波形和頻域響應分析的各種測量數據，可提供給經銷商和消費者以供參考，有助於促進產品的市場銷售。

以往木管樂器簧片市場，主要是使用以天然蘆葦 (Giant Cane) 材質為簧片材料，使用者購買天然蘆竹簧片 (Cane Reed) 後，仍需自行使用簧片專用修剪器、細水砂紙及其他工具，反覆修剪、細磨、調整及試吹，直到吹奏比較輕鬆，音色自覺滿意為止，過程相當耗時費工，一般而言，天然蘆竹簧片使用一周之後，音色就會改變或簧片前端損毀，必須更換簧片。近年來，國際木管樂器簧片市場上，合成簧片逐漸普及，合成簧片具有比天然蘆竹簧片更耐用、可靠的優勢（可使用 3 至 4 周），使用前不需要先行濕潤，使用後不需要任何特殊

照顧，因此合成簧片近幾年獲得了更多的市佔率與使用者的肯定，在業餘的木管樂器表演者與學習者之間不斷擴大流通。

合作廠商設計研發合成簧片，為確保產品的頻率、音色有國際大廠的水準，能進入高單價的國際市場，委由本實驗室協助開發木管樂器簧片的時域與頻域響應測試系統，可用於檢測合作廠商所生產，所有的單簧片樂器使用之合成簧片，包含 Clarinet、Saxophone (Soprano, Alto, Tenor)；此木管樂器簧片的時域與頻域響應測試系統已經能正常使用，從無響室之規劃與設計、簧片測試系統音頻響應校準之規劃與設計、簧片發聲系統之規劃與設計、簧片時域與頻域響應測試系統之規劃與設計、簧片實際測試與記錄，並且與市場上高知名度國際大廠的簧片做比較。此系統具有可視化的時域波形及聲學的圖形化頻譜，可視化界面提供了更多的信息，可以幫助製造商直接瞭解合成簧片的品質。

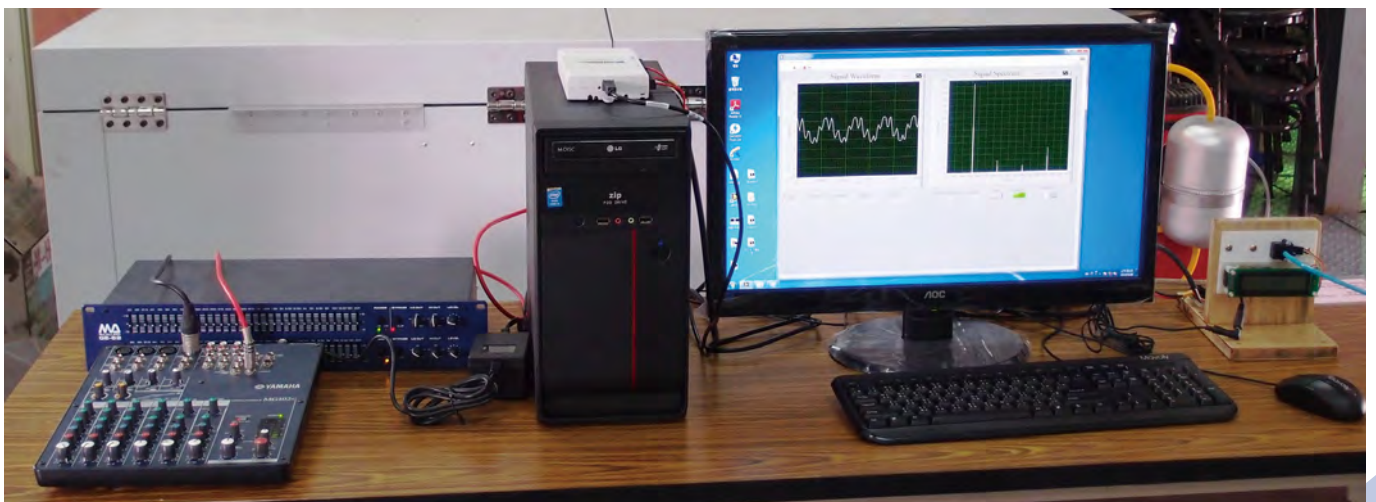


圖 1 / 簧片時域與頻域響應測試分析使用之設備



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分別於 1992 年及 1995 年獲得美國杜蘭大學 (Tulane University) 電機工程碩士 (M.S.E.E) 與杜蘭大學 (Tulane University) 電機工程博士 (Ph.D.E.E)。曾於 1988 年至 1989 年間擔任美商汎利工程顧問公司之工程師，1996 年至 1998 年任職於南榮技術學院電機工程系系主任一職，2007 年擔任美國德州休士頓大學訪問學者。現職為建國科技大學電機工程系副教授。

研究領域

最佳化控制、超音波測距系統、電子電路設計、數位訊號處理、模糊與類神經控制、灰色系統理論應用、可程式系統晶片。

Abstract

The work aims to reveal the design and primary test results of a time and frequency response analysis test platform for woodwind reed. Nowadays in the musical instrument market, the woodwind reed is scaled in a strength chart by testing its stiffness. In this project, a time domain and frequency response analysis test platform is presented to provide the visualized waveform and graphic spectrum of acoustic sound. The provided information can help the synthetic reed manufacturer to scrutinize the quality of a reed directly. Also, a variety of measurement data from time-domain waveform and frequency-domain response analysis can be provided to the dealers and consumers for their reference to promote reed products.

Woodwind instruments produce sound by blowing air into a mouthpiece which then causes a reed to vibrate and generate the sound. Most of the reeds for woodwind instruments are made from giant canes or synthetic materials. Woodwind players buy commercially manufactured cane reeds, although many players adjust them by trimming and sanding cane reeds using special tools, a process which was time-consuming and painstaking.

However, cane reeds do not last long for use. Synthetic reeds are made from synthetic polymer compounds. They are more durable and reliable than cane reeds, do not need to be moistened prior to playing and do not need any special care after playing, and the synthetic reed quality is consistent. Therefore, synthetic reeds have gained more acceptances and market shares are expanding among amateur players and students in recent years.

This time and frequency response analysis test platform for woodwind reed includes the following subsystems: an anechoic chamber, a microphone frequency response calibration system, an artificial reed-blowing system, a high resolution pressure gauge, and a time and frequency response analysis and control system. This system provides the visualized waveform and graphic spectrum of acoustic sound for testing all kinds of woodwind reeds such as reeds for clarinet, saxophone (soprano, alto, or tenor). The provided information can help the synthetic reed manufacturer and dealers to guarantee the quality of a reed directly.

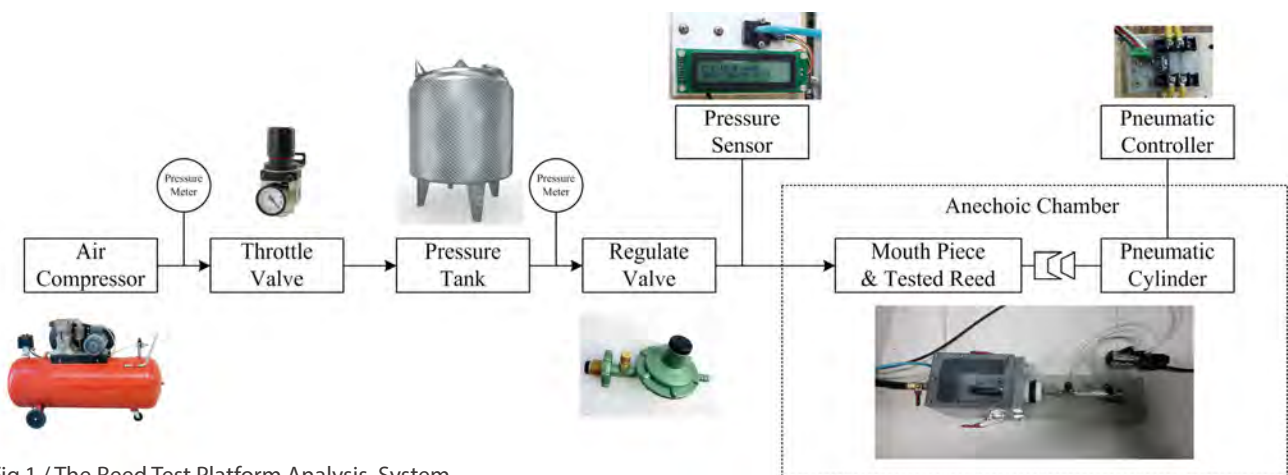


Fig.1 / The Reed Test Platform Analysis System