• 計畫中文名稱	上肢支架融合型功能性電刺激系統之研發與整合		
• 計畫英文名稱	Development and Integration of an Orthotic Hybrid Fes System for Paralyzed Upper Limbs		
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• 執行機構	臺北醫學大學醫學系		
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• 研究領域	醫學工程		
• 研究人員	陳適卿,游忠煌,郭德盛,劉正良		
• 中文關鍵字	上肢癱瘓；上肢裝具；支架融合型功能性電刺激；神經科技輔具		
• 英文關鍵字	upper limb paralysis；orthosis；hybrid functional electrical stimulation,assistive technology；neuroprosthesis		
• 中文摘要	對於上肢癱瘓病人而言，因喪失肢體功能，故許多日常生活皆無法自理(如：吃、 喝東西、刷牙、寫字…等)，造成生活上極大不便，且亦增加家庭經濟與精神上的負擔， 爲改善此困境，我們迫切希能重建這些病人的上肢功能。 在國外，對於上肢神經科技輔具大多著重於手部功能的重建，如 FreeHand (USA) 和 Hand Master (Israel)二套系統。至於較近端的上肢動作，如肘部與肩部的動作控制及 伸展等，則無法有效控制，目前仍有許多地方需要改進。所以本研究的主要目的是利用 神經科技輔具技術發展，適當地結合上肢支架副木裝具，再加上生理訊號回饋，發展一 套支架融合型功能性電刺激系統 Orthotic Hybrid Functional Electrical Stimulation (FES)， 以重建上肢癱瘓者的肢體(含肩、肘、腕部)功能。 爲達成此目標，尚有很多方面的工作必須努力，幸運的是有許多工作已經在先前 有關神經科技輔具於重建脊髓損傷者手部功能的應用研究研究中 (NSC-90-2614-E-038-003)(NSC-91-2614-E-038-001)建立相當好的基礎。本研究團隊目前 已可順利藉由功能性電刺激完成手部三個主要動作(包括 cup grasp, key pinch and 3-jaw prehension)。 本計畫結合之前完成手部控制的成果，將研究由手部動作延伸至肘及肩部， 並加上支架副木裝具，讓上肢癱瘓病人可以利用這種支架融合型功能性電刺激系統協助 重建其喪失的上肢運動功能及肢體活動。 此計畫的工作預計三年完成， 第一年著重發展上肢取物時之肘肩部動作分析及肘肩部肌肉生理參數架構與支架 輔具控制模型，並研發輸入器及控制器(input device and controller)。 第二年結合之前手部 FES 之研究成果，並設計加上支架副木裝具(Orthosis)之功能性 電刺激系統雛型，即所謂支架融合型 FES 系統，讓整個手、腕、肘、肩動作能更加順 暢，且測試改良結合上腕肘肩動作後之整體上肢功能性動作，使整體 Orthotic Hybrid FES 系統動作控		

	制更好。 第三年將完成最後的系統微型化整合並增加病人數進行系統測試實作分析，達臨床 輕便實用。 經過三年研究，預計將可延續我們先前已完成的重建上肢癱瘓病人手部抓握功能， 更發展出腕、肘、肩部整體上肢動作，使可順利伸曲肘部及抬起上臂取物，以幫助他們 達成日常生活功能，造福更多上肢癱瘓者。
• 英文摘要	Patients with upper-limb paralysis who lost their hand functions cannot independently perform activities of daily life (ADL), such as eating, drinking, brushing teeth, writing, etc. Being unable to perform these activities independently, their quality of life is much decreased and it may increase the loading to their families both economically and psychologically. Therefore, under strong demand of these patients, we plan to develop an assistive devise which would restore their upper-limb functions with the hybrid functional electrical stimulation (FES). Nowadays, there are many applications of neuroprosthesis (NP) developed, e.g. FreeHand system (USA) and HandMaster (Israel), and they mainly focus on hand function restoration. However, they don『t put much emphasis on the control of elbow and shoulder joints. Due to weakness of the proximal part of upper limbs, patients cannot control their shoulders and elbows well, let alone ADL. To solve this problem and to extend the application, we would like to utilize the NP technique with adequate orthosis to develop an orthotic hybrid FES system to restore upper-limb (including shoulder, elbow and wrist joints) functions. To achieve this objective, many tasks need to be performed. Fortunately, we have well performed the projects for restoring hand functions of patients with upper limb paralysis. Three main hand functions (cup grasp, key pinch and 3-jaw prehension) can be performed by using the self-developed FES system in previous studies. Due to weakness of the proximal part of upper limbs, the FES system for hand motion alone is inadequate to perform activity of daily living. We plan to further extend its application to restore wrist, elbow and shoulder functions as well. We also plan to further develop an orthosis for supporting and guiding paralyzed upper limb motion and for easy doffing and donning, so that the orthotic hybrid FES system will be practically useful. It is expected to be a three-year project. 1. In the first year, we will adapt the previous research experience in FES hand functions to study the wrist, elbow and shoulder functions. The extension of experience includes (a) to extend hand motion analysis and muscle profiling to wrists, elbows and shoulders (b) to establish the electrical stimulation parameters and stimulation patterns for motion of wrists, elbows and shoulders (c) to design and develop an input device and command controller. (d) to develop an orthosis model and sensor system for adapting the FES system. 2. In the second year, we will combine our previous achievement and develop a orthotic hybrid FES system for upper-limb paralysis patients. The work on this stage will focus on the using upper-limb orthosis to smooth the upper-limb functions, that means the shoulder or elbow joint can be well controlled by the patients. 3. In the third year, the work will focus on the integrating and minimizing all the subsystems and upgrading the performance of the hybrid FES system. Setting measurement and evaluation protocols to refine the orthotic hybrid system will also be performed.