混合動力系統之內燃機節能技術研究

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- 針對合作廠商華創公司複合動力系統EV-X4 Gen1和Gen2架構，設計適應性能量管理策略，並利用Atkinson循環引擎改善引擎油耗，以及發展缸內直噴GDI引擎層狀燃燒技術，這些技術整合已達改善整車燃油經濟性30%的計畫目標。運用此技術，可以大幅降低車輛能耗，協助車輛產業技術升級並通過耗能法規。

- 104獲證專利1件(設計增程式電動載具之能量管理策略的方法、其策略及其應用)
- 105獲證專利2件(增程式電動載具之能量管理系統及其能量控制方法、降低引擎啟動扭力的控制方法)
- 106申請四件專利(油電混合車之動力耦合機構eCVT變速控制策略設計、電池電量狀態與健康狀態之適應性估測方法、Atkinson cycle最佳化控制、層狀燃燒之燃燒時間點回授控制)

- 本計畫聚焦於前瞻內燃機技術，發展Atkinson cycle引擎、GDI層狀燃燒以及整合於混合動力系統以驗證整車節能效果。依此分三個子計畫，分別是：(1)系統能量管理與動力分配控制、(2) Atkinson循環引擎技術研發及GDI燃燒系統設計、(3)缸內直噴控制技術研發。全程計畫三年(2015~2017)，目標為：(1)華創公司油電混合車EV-X4燃油經濟性比原汽油引擎車改善30%以上，(2) Atkinson循環引擎及GDI引擎耗油率(brake specific fuel consumption, BSFC) 與原引擎比較，分別改善15%以上。已達成目標：子計畫一適應性能量管理控制策略(Adaptive PMS)模擬之燃油經濟性改善達44.5%，子計畫二完成Atkinson Cycle 引擎實驗油耗改善16%以上，子計畫三達成在特定操作點下之BSFC改善達15%以上。另外，執行計畫期間投稿許多國外研討會論文，其中一篇論文投稿(ICATYE)獲得Best Paper Award。

NEDC油耗測試		
Classification	**Fuel Economy (km/L)**	**Improvement (%)**
U7 2.2T Eco (官網公告)	**11.7**	**0**
EVX4 HEV (本計畫控制策略)	**16.91**	**44.5**

Development of ICE Energy Saving Technology for Hybrid Electric Vehicle

Execution Unit	National Taipei University of Technology Vehicle Technology Research & Development Center
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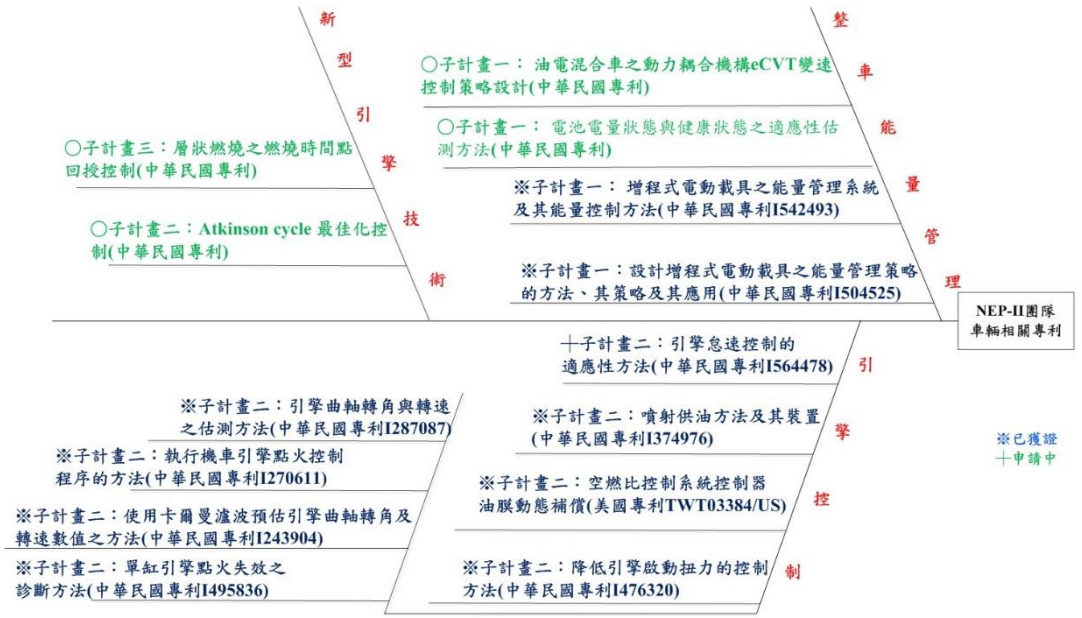
- This project focused on the development of adaptive energy management strategy for EV-X4 gen1 and gen2 configurations. The energy saving of ICE (internal combustion engine) applied Atkinson cycle to reduce the fuel consumption, and developed the stratified combustion technology of a GDI engine. All these technologies were integrated in hybrid powertrain and improved the fuel economy, which can be directly implemented for automobile industry.

- 2015 Got one patent: A design method for managing the power of a range-extended electric vehicle.
- 2016 Got two patents: Power management system of range extended electric vehicle and method of power control thereof, An investigation on cranking torque reduction for four-stroke motorcycle engine.
- 2017 Applied four patents: Design of continuously variable speed control for the torque coupling mechanism of a hybrid electric vehicle, Adaptive estimation method of state of charge and state of health for battery, A closed-loop control of combustion timing in stratified mode combustion, Technology of optimal control strategy of the Atkinson cycle engine.



- This project puts a lot of efforts on the advanced engine technologies. Atkinson cycle engine and gasoline direct injection (GDI) engine are studied. The fuel economy of the vehicle was evaluated with the proposed hybrid powertrain. There are three subprojects: (1) Energy Management of the HEV System and Control of Power Distribution; (2)Develop the Atkinson Cycle Engine and GDI engine Lean Burn System; (3) Develop the Control Technology of GDI Engine. The total period of this project is 3 years, from 2015/01/01 to 2017/12/31. The goal of this project contains: (1) Improve the HAITEC EV-X4 hybrid electric vehicle (HEV) fuel economy by 30%, as compared to the original internal combustion engine vehicle; (2) Reduce the engine brake specific fuel consumption (BSFC) by 15% with either Atkinson cycle engine or GDI engine as compared to its original engine. The goals of this project have been achieved. A 44.5% fuel economy improvement is reached with the proposed adaptive PMS. The Atkinson cycle engine reduces its fuel consumption up to the level of 16%. GDI engine also meets the 15% fuel consumption improvement within certain operation range. Except for the achievements mentioned above, paper submissions to international conferences were continuously undertaken during this period, and one of them won the Best Paper Award in ICATYE.

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