

行星表土準備系統 Soil Preparation System (SOPSYs)

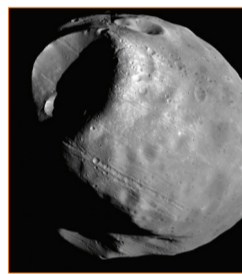
探察「火衛一」(火星的衛星)生命蹤跡的表土採樣工具
Soil sampling tool for exploring life on the Martian moon

「火衛一·土壤」(Phobos-Grunt) 是中俄兩國首次合作的策略性太空計劃。通過這項任務，兩國曾試圖在火星衛星「火衛一」的表面著陸，並採集其上的土壤本和進行實地分析。理大負責研發的「行星表土準備系統」在整項任務中起著關鍵作用。此系統將被應用到未來的火衛一探索任務中。

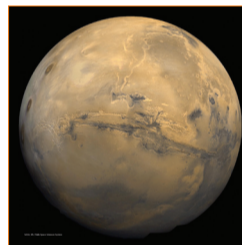
「行星表土準備系統」體積輕巧，能夠把火衛一的表層土壤磨碎及篩選出直徑少於一毫米的樣本，以便進行實地分析，分析結果對於宇宙演化的研究至為重要。此系統的技術更被運用到「相機指向機構系統」中，並已隨嫦娥三號到達月球，圓滿完成任務。



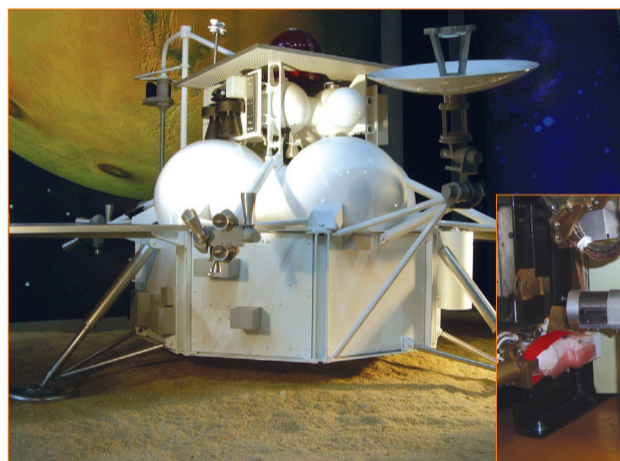
俄羅斯太空署 (IKI)「火衛一土壤」任務科研人員訪港
Phobos-Grunt Mission team of Space Research Institute of the Russian Academy of Science (IKI) visited PolyU project team



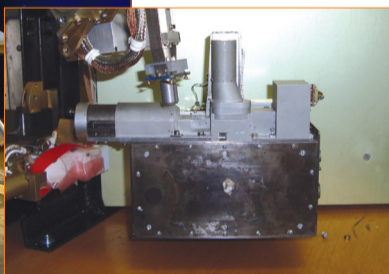
火衛一
Phobos



火星
Mars



「火衛一土壤」探測器模型
Model of Phobos-Grunt lander



行星表土準備系統於俄羅斯太空署 (IKI) 進行功能測試
Soil Preparation System for functional test at Space Research Institute of the Russian Academy of Science (IKI)

Soil Preparation System (SOPSYs) is a mission-critical space tool developed by PolyU for the Phobos-Grunt Mission, the first strategic interplanetary exploration of the Sino-Russian collaboration which led to historical attempts to land on the Martian moon Phobos, collect soil samples there and conduct in-situ analysis. This tool will also be used for the coming mission to explore Phobos.

SOPSYs is compact and lightweight for grinding and sifting Phobos rocks to sub-millimeter size for in-situ analysis, which is a crucial step in understanding the evolution of the universe. Some of the technologies developed for SOPSYs have been applied in the Camera Pointing System for the successful Chang'e-3 lunar mission of China.

Principal Investigator

Prof. Kai-leung YUNG

Department of Industrial and Systems Engineering

Contact Details

Institute for Entrepreneurship

Tel: (852) 3400 2929 Fax: (852) 2333 2410 Email: pdadmin@polyu.edu.hk

特色與優點

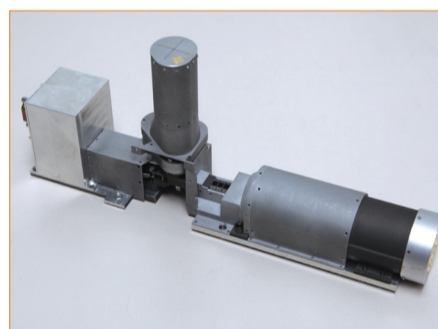
- 體積輕巧，僅重四百克
- 在真空及微重力的環境下把土壤磨碎
- 只有微量引力的環境下進行土壤篩選
- 把固態粒子磨成液化粉末以克服微重狀態環境
- 能在惡劣的太空環境中發揮多元智慧功能，解決不可預計的問題，如太多堅硬石塊碎片引致的淤塞
- 工作完成後會自行清潔，並把未磨碎的石塊棄掉，以樣本之間互相污染
- 能自動量度樣本的密度及體積

應用

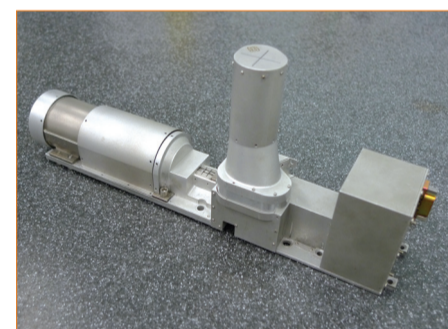
- 能在極端溫差、無重狀態、真空、多塵及充滿宇宙射線的惡劣環境中進行自動控制及發揮人工智慧功能
- 把土壤磨碎並篩選毫米以下的樣本進行實地分析
- 技術轉移潛力高，可用於其他機械設計

獎項

- 第42屆瑞士日內瓦國際發明展 - 評判特別嘉許金獎 (2014年4月)
- 俄羅斯Gorodissky & Partners特別大獎 (2014年4月)



行星表土準備系統的鑒定件
Qualifying Model (QM) of Soil Preparation System



行星表土準備系統的航天件
Flight Model (FM) of Soil Preparation System

Special Features and Advantages

- Compact package of under 400 grams
- Grind rocks under vacuum and low gravity
- Sift grinded rock powder with low gravitational force assistance
- Overcome low gravity by fluidisation of grinded solid powder
- Multi-intelligent functions in the space environment to cope with various unforeseen hazards such as jamming due to excessively hard rock fragments
- Self-cleaning and un-grinded rock fragment disposal facilities to minimize cross contamination between samples
- Automatic measurement of density & volume of samples to be examined

Applications

- Automatically control and perform multi-intelligent functions in extreme conditions including large temperature difference, lack of gravity, vacuum environment, dustiness and cosmic radiation
- For grinding and sifting rock samples to less than 1mm in diameter for in-situ analysis
- With huge potential for applications in other machinery

Awards

- Gold Medal with the Congratulations of Jury – 42nd International Exhibition of Inventions of Geneva, Switzerland (April 2014)
- Prize of the Legal Company “Gorodissky & Partners” - Russia (April 2014)



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