UCL (AUSTRALIA)

Research Proposal: Assessment of hyperfine hyper-spectral remote sensing in Australian resources sector – stage One

1 OBJECTIVE

Satellite and aircraft mounted cameras (hyper-spectral sensing) can be used to measure gas emissions. Such measurements can differentiate sources of green house gases as well as identify sites of potential interest for exploitation and characterise biological materials (the biomass). In recent years significant progress has been made on a range of emerging remote sensing technologies with substantially improved resolutions. UCL is at the forefront of this development and proposes that such capabilities are further improved and applied to the energy sector. The overall objectives of a programme in this area are:

Stage One:

- Assess current technology in the context of the Energy Sector's specific needs and to create technology performance models.
- Identify technological improvements (both instrumentation and data reduction) necessary to meet the Energy Sector's needs and determine the relevant and specific benefit trade-offs
- Perform some airborne trials of existing technology, together with controlled venting to validate parts of the performance model from 1.1.

Stage Two:

- Ground Demonstration of a hyper-spectral imager capable of differentiating CH_4 isotopologues with a sensitivity and spatial resolution appropriate to the needs of the energy sector

Stage Three:

- Deployment and operation of a hyper-spectral imager

2 THE MULLARD SPACE SCIENCE LABORATORY

The Mullard Space Science Laboratory (MSSL), part of University College London, is Britain's largest university-based space science research facility. UCL established an office of MSSL in Australia (Adelaide) in 2012, to complement the university's School of Energy and Resources, Australia which works in the minerals, energy and natural resources areas. MSSL delivers a broad, cutting-edge science programme, underpinned by a strong capability in space science instrumentation, space-domain engineering, systems engineering and project management. While primarily known for its space science programme, MSSL

undertakes research in a variety of ground-based domains and much of its instrumentation has dual use.

3 PROJECT OVERVIEW

UCL proposes a three to four year research project to develop very high spectral resolution imaging instruments to detect and map Methane (CH_4) seeps. The proposed technology is expected to separate CH_4 isotopologues and hence determine the contribution of the detected CH_4 from biogenic (flora and fauna) or abiogenic (geological, resource production or fugitive emission) sources. This capability will enable both resource exploration and the accurate monitoring of any fugitive emissions for industry.

The project would aim to include a demonstration on a low-flying aircraft using existing technology with a long-term goal to mount an instrument on a high altitude platform (such as a stabilised balloon) flying at >20,000m for large area mapping over the Australian continent.

4 STAGE ONE PROGRAMME

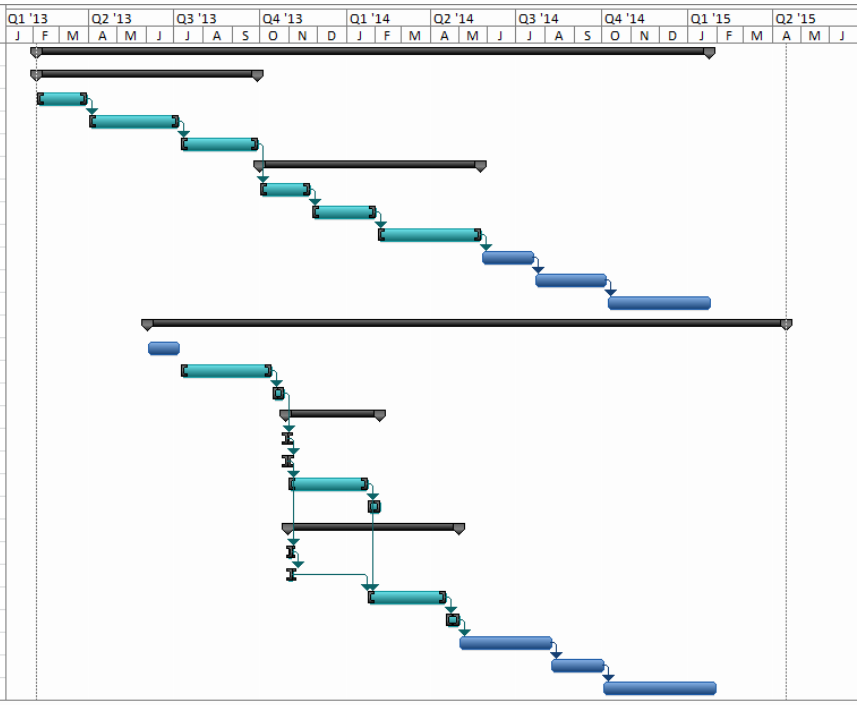
This initial stage proposes two Post Doctoral Research Assistants working for 2 years on related, but separate, research streams. The researchers would be based at UCL's Mullard Space Science Laboratory office in Adelaide. Stage 1 would commence in February 2013. The two themes involve:

Existing satellite data analysis; Stream 1: From early 2013, this would involve the analysis of existing satellite data to determine CH_4 emissions over the Australian continent using hyperfine spectral resolution data from the Jaxa GoSAT and the Canadian ACE/FTS instruments. This will provide an understanding of the efficacy of current technology and analysis techniques and to specify more precisely the requirements for future developments, for both the instrumentation development and the analysis software. This would then enable the definition of the technical requirements for an instrument with the needed capability and allow an initial assessment of performance characteristics associated with the proposed technology. The Stream would also include an analysis of energy sector needs, leading to requirements and the creation of cost/benefit trade-studies based upon a derived technology performance model.

Australian aerial survey; Stream 2: Starting in early 2014 the second stream will define (based on the outputs of Stream 1) and carry out an aerial survey over suitable land and ocean environments in parts of South Australia, (e.g. the Cooper Basin). This will make use of existing detector technologies and custom optics to simulate the performance of the final instrument over a limited wavelength range. These surveys will allow us to validate the performance models derived in as part of stream 1. Coordination with industry will allow the survey to coincide with known venting events and thereby provide a ground truth calibration.

5 SCHEDULE

ID	WBS	Task Name
1	**1**	**S1: Feasibility analysis**
2	**1.1**	**GOSAT study**
3	1.1.1	GOSAT data retrieval
4	1.1.2	GOSAT data analysis
5	1.1.3	Algorithm optimisation
6	**1.2**	**ACE study**
7	1.2.1	ACE data retrieval
8	1.2.2	ACE data analysis
9	1.2.3	Algorithm optimisation
10	1.3	Generic algorithm development
11	1.4	Code development
12	1.5	EO derived data assessment
13	**2**	**S2: Survey**
14	2.1	Assessment of filters
15	2.2	Design & Build Test Camera
16	2.3	Plan Survey
17	**2.4**	**Land Survey**
18	2.4.1	Prepare Aircraft
19	2.4.2	Perform Survey
20	2.4.3	Data Analysis
21	2.4.4	Report
22	**2.5**	**Ocean Survey**
23	2.5.1	Prepare Aircraft
24	2.5.2	Perform Survey
25	2.5.3	Data Analysis
26	2.5.4	Report
27	2.6	Algorithm optimisation
28	2.7	Generic algorithm development
29	2.8	Assessment of HAP



6 STAGE ONE COSTINGS

	12/13	13/14	14/15	TOTAL
Total Staff Costs	232.9	326.5	73.6	**632.9**
Equipment	5.5	0.0	0.0	**5.5**
Consumables	1.5	2.0	0.5	**4.0**
Travel	5.1	4.2	3.6	**12.9**
Exceptional Items:	0.0	40.0	0.0	**40.0**
Land Survey		*15.0*		
Ocean Survey		*25.0*		
TOTAL	**245.0**	**372.7**	**77.7**	**695.3**

Stream 1				
TOTAL	166.9	167.4	2.0	**336.2**
Stream 2				
TOTAL	78.1	205.3	75.7	**359.1**

All costs in A$ ('000)

7 FULL PROGRAMME

Stage One: described above

Stage Two (NEW): Starting in 2014/2015, and following on from the initial assessment in stage one, will involve the development and ground demonstration of an instrument based on Fabry-Perot interferometry or AOTF technology with spectral bands at 1.6µm or 2.3µm and resolution of <0.02nm. Details and requirements of this instrument will be informed by the outputs of Stage One.

Stage Three (NEW): The final stage involves the development and demonstration of the full capability detection capability and is expected to include: a suitable High Altitude Platform, integration of the instrument., operations and data download, storage, analysis/reduction and appropriate dissemination.

8 CONTACTS

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