Conall DE PAOR

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À: Conall DE PAOR
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- Moneyball Newsletter -

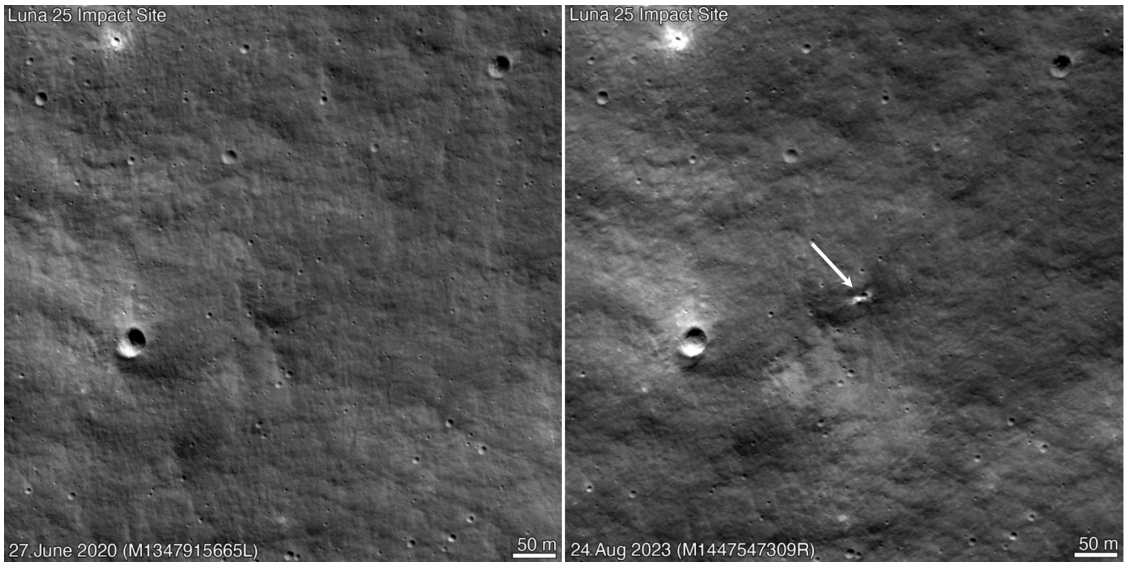
Conall de Paor

29th of February 2024

Today, the Moneyball project is two months old. In that time, two spacecraft have landed softly on the moon: SLIM of Japan and IM-1 of the United states. The interval of just 34 days is the shortest interval between successful moon landings since Luna 21 landed 32 days after Apollo 17 in January 1973.

In this monthly newsletter about my PhD there are:

- Some nice pictures,
- A progress update
- Meeting Log
- An outlook for the next month.



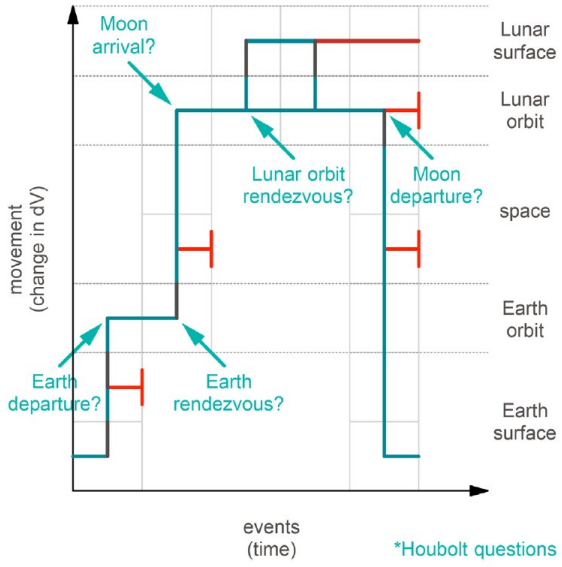
Impact site of Luna 25 in August 2023. The first Russian lander since 1976, failed to shut down its main engine during a pre-landing maneuver due to a software error. It is the 4th lander in 5 years to crash on the moon due to software. the others being Beresheet, Chandrayaan 2, and Hakuto R

PROGRESS REPORT

Describing the Design Space of Space Mission

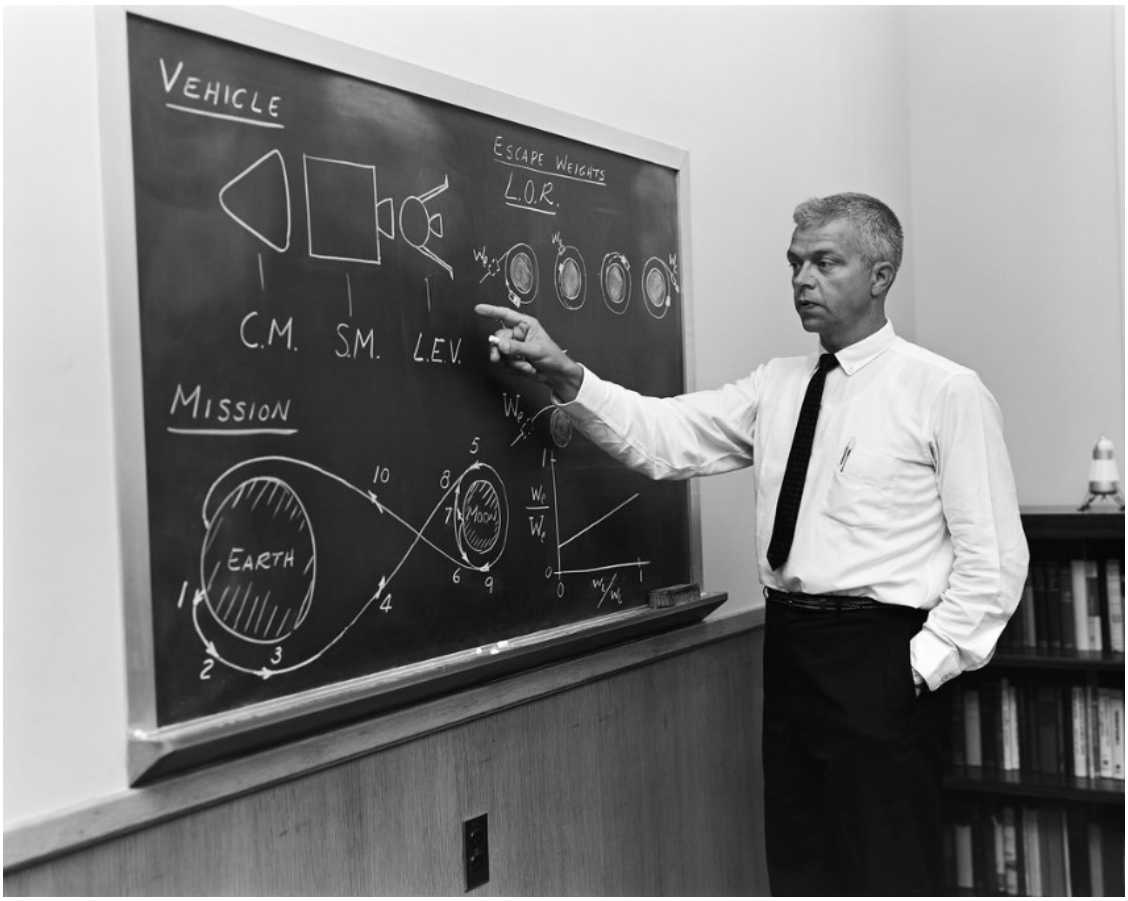
In order to comprehensively search the design space for a given space mission, we need a way to efficiently describe them. Two good candidates for this are pattern languages and houbolt questions.

Pattern languages are a set of symbols arranged together according to simple grammatical rules which describe the concept of operations of a space mission. Below is a description of the Apollo 11 mission using them from Ruede et al. 2021.



The Apollo mission architecture rendered using pattern languages

Houbolt Questions are key questions about the architecture of the mission such as propellant choice, reusability considerations, and rendezvous strategies. Term coined for John Houbolt who pushed for the lunar orbit rendez-vous idea which enabled the Apollo missions.



John Houbolt pushing the Lunar Orbit Rendez-vous idea in 1962

The idea is that by arranging different combinations of pattern language symbols and houbolt questions, we can describe every mission in the design space and then estimate the cost of all of them in order to find the pareto-optimal set of mission architectures

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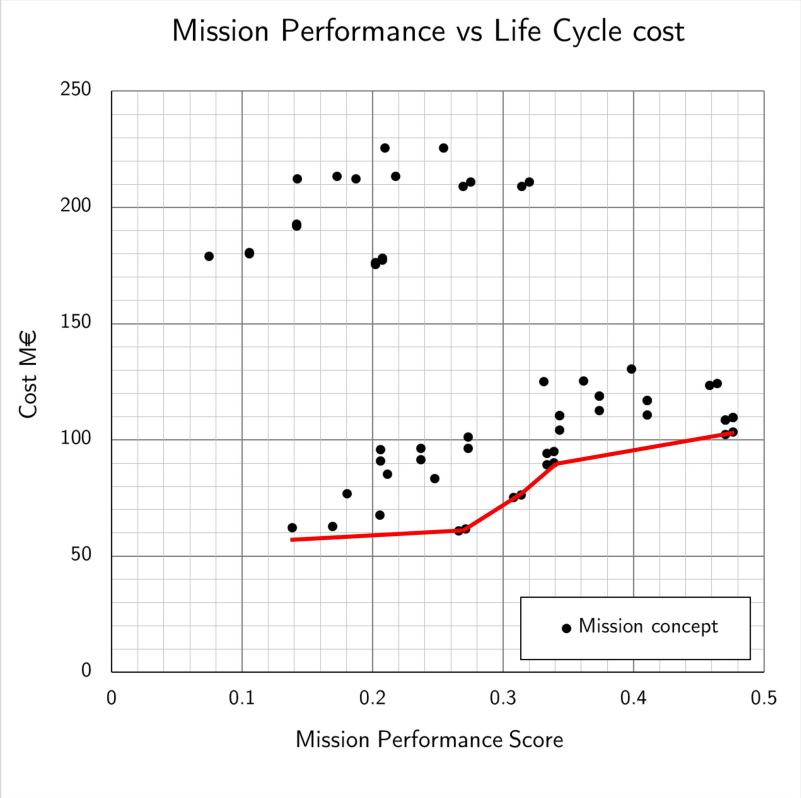
Finding the pareto-optimal set of missions

It is envisaged that when the members of the design space are plotted on a cost performance graph that there will emerge some front past which it is not possible to achieve higher performance without higher cost. Below is an example of this front arising from a trade-study on responsive space systems in 2023.



The Pareto front in red for a set of mission architecture candidates for a responsive space system.

IAC 2024

An abstract related to the Moneyball project was submitted to the Space Systems Symposium at IAC 2024 in Milano. The paper title is *Moneyball - Finding Low Cost Mission Architectures By Design Space Exploration Using Pattern Languages and Houbolt Questions.* It will look at the Rosetta/Philae mission as a case study to validate the design space search method.

CIFRE Dossier status

The CIFRE dossier has been submitted and is being evaluated by the *Agence Nationale de Recherche Technologie.* Once it is accepted, I will be able to enroll in the EDSYS doctorale school and the academic clock of the PhD will start.

Alten Supaero Joint Meeting

On the 14th, there was the first meeting between Alten and Supaero supervisors of Moneyball. Sebastien Maes of Alten and Professor Lizy-Destrez of Supaero and I ate croissants and discussed the roles of the various supervisors on the PhD.

English Irish Dictionary of Space Related Terminology

Found this very cool book. 3500 space words translated to Irish. Some nice words include:
Earth : *Domhain*
Moon : *Gealach*
Orbit : *fithis*
You can find the book here: *https://www.amazon.co.uk/English-Irish-Scientific-Technological-Space-related-Terminology/dp/1846822696*

Toulouse as seen by Pleiades in 2012

MEETING LOG

A log of all scheduled meetings this month with their subjects. Informal meetings not included.

Monday 12th: Professor Sanchez:
Pattern Languages, Uncertainty estimation

Wednesday 14th: Professor Lizy-Destrez, Sebastien Maes:
Introduction Alten-Supaero, The role of the various supervisors

Friday 23rd: Julien Lafforgue
Role of the PhD for Alten Labs

Monday 26th: Professor Sanchez:
Reading Reude et al, describing the search space, Lagrange multipliers and The Jeep Problem

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OUTLOOK

The goals for March are

- Joint meeting with all four supervisors
- Developing the houbolt questions and pattern languages for design space exploration
- Adapt the Jeep Problem to the staging / rendez-vous question.
- Literature review for IAC 2024
- Joint meeting with the two supaero supervisors

That's the news for February.

Thank you for reading
Conall