Hacking, Tinkering & Practical Jokes On Orbital Space Stations – Notes On Slow Technology Aspects

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ABSTRACT
This position paper considers the practice of re- or para-utilising hardware by individual users onboard orbital space stations through the lens of Slow Technology. Astronauts and cosmonauts have been using fractions of their off-duty time to repair, playfully modify or hack their habitat environment for purposes of non-essential housekeeping, entertainment or pleasure. This was afforded partially through the dynamics of content influx in an incrementally designed and inhabited structure. However, a custom-built spacecraft for future deep space missions is unlikely to have hosted an iteration of several previous crews and cannot be resupplied; it therefore lacks the kind of accumulated hardware content available to the user in orbital habitats to date. Observing 'slow' practices and examining the tangible situation from which they emerge in the particular case of space habitats can inform our understanding of the potential leverage for un-protocolled, reflective engagement with bespoke systems in other contemporary technology contexts.

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Space Stations, Hacking, Practical Jokes, Ethnographic Accounts, Para-Use, Hardware Legacy, Slow Technology

ACM Classification Keywords
User Interfaces, Design, Human Factors, Theory

HACKING & PRACTICAL JOKES IN ORBIT AS SLOW TECHNOLOGY PRACTICE

Moving at an orbital velocity of 27,743.8 km/h, the International Space Station (ISS) is perhaps likely to be the fastest technological artefact of our times. Yet, due to reduced gravity conditions, human interaction with hardware in this interactive, computer-controlled habitat – whether onboard systems or housekeeping items – is comparably slower in pace than under terrestrial gravity conditions. It is for a less literal reason, however, that human-technology interaction in orbital habitats can serve as case study for less extreme contexts in relation to Slow Technology. Aside from acutely safety-related improvisations in spacecrafts (e.g. during the Apollo 13 mission), astronauts and cosmonauts hack their environment by modifying onboard equipment for non work-related purposes.

Instances of hacking, particularly in the sub-category of practical jokes, are reported anecdotally in user accounts of virtually all historical space stations (incl. Salyut, Skylab, MIR, ISS). Examples include bringing purpose-made props to pretend the success of an experiment towards ground-based scientists [1]; rigging equipment in situ to startle fellow onboard crewmembers [2,3]; or pre-manipulating communications messages to tease ground control or visiting crews [3]. Leaving a legacy to other users is a frequent theme, not just through pranks, but also through designated written signs, or thoughtful, conscious measures such as storing popular leftover food rations specifically for subsequent crews. Yet another dimension includes the re-use of material to create artefacts associated with customs, rituals or values important to the user group (e.g. a Christmas tree made from discarded food containers by the crew of Skylab 4).

One of the most prolific and well-documented users in the category of science and engineering-related experimental tinkering is NASA astronaut Donald Pettit. To get an impression of Pettit's work during one long duration mission on ISS between December 2002 and November 2003, 29 items of archived public outreach video material were reviewed, and an inventory of the material used was compiled (See Appendix). The documentation exposes several dimensions of his activities: they are corrective (repairing wristwatch), inventive (amplifying functions of a camera with a drill), or insightful (exposing hidden characteristics or behaviours of fluids, mechanical devices etc. in microgravity).

Such 'slow' practices are of a different quality than other interaction with onboard hardware that can feature significant 'unintentional slowness' [4] – i.e. frustration with the highly complex and often also highly complicated design of human-machine interaction inside orbital

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structures. Rather, hacking activities in an off-duty context can be described as mindfully engaging, immersive, reflective, restorative, delightful or relaxing [5]. Users appear to derive both intellectual stimulation and play-value (surprise, insight, satisfaction of curiosity) from these ‘tasks’; they are open-ended, explorative, un-defined rather than clear-cut and predetermined [4]. Particularly in a non-autonomous habitat setting governed predominantly by protocols, procedures and close cooperation with ground control, ‘slow’ occurrences of tinkering appeared to open pockets of time for the user in an otherwise tightly organised work and life schedule.

AFFORDANCE OF SLOW PRACTICE THROUGH ACCUMULATION OF HARDWARE

The affordance for hacking or general modification in the particular socio-technical system of a space station is facilitated by a range of factors that concern its overall programme paradigm and operations, illustrated here at the example of ISS.

On one hand, ISS is not the product of a single, channelled design effort but a modular, cross-national agglomeration of iterative hardware legacies of previous space programmes and purpose-built appendices. The compatibilities and idiosyncrasies between design philosophies of different contributors are distinctly manifested in the habitat system; they both necessitate and invite user engagement in the form of routine maintenance and experimental modification.

On the other, the operations over the last decade have seen a turnover of dozens of different overlapping crews with specific work-related payload and housekeeping hardware, and a constant series of cargo resupply. While much content is purged from the station after use (i.e. collected, stowed and de-orbited in a designated spacecraft, or, to a more limited extent, brought down to ground for further use or servicing), each crew also leaves a portion of hardware (equipment, tools, consumables) behind. These items are in different stages of their life cycles. This continuous process results in an accumulation of stowed material that is technically available for re- or para-utilisation.

DESIGN ISSUES IN LIGHT OF BESPOKE SYSTEMS

In future mission paradigms with deep space destinations such as Near Earth Asteroids or Mars, however, an itinerant habitat-vehicle is likely to be custom-built less incrementally, and is unlikely to have hosted preceding crews. Due to its distance and remoteness, the vehicle will not be resupplied with cargo, or receive changeover crews that bring additional items. In terms of hardware, it will be a closed-loop system with no comparable possibility for a continuous stream of hardware that so well afforded ‘slow’ engagement. It is also likely that the overall habitat system is more homogeneous (i.e. a product of a concerted effort of several distinct partners) than ISS today, thus offering less room for idiosyncrasies that invited reflective tinkering. Yes, its unprecedented autonomy would benefit from resourcefulness and related user interaction [6].

Opportunities for reflective practices such as tinkering and hacking do not necessarily depend on the pre-requisite of a pre-utilised, open loop system. They do benefit from a certain degree of plasticity, complexity or malleability, however [7,8]. The phenomenon of hardware accumulation on different paradigms of space habitats (ISS v. deep space vehicle) can be read as analogy for other one-off, bespoke or next generation systems that do not feature previous user generations or are radically (rather than incrementally) designed. Understanding these design interactions in the ‘petri-dish’ of space platforms, and relating them to the qualities, emergence and dynamics of the particular system can enrich our perspectives on issues of legacy in, and affordance of, Slow Technology.

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APPENDIX: ARTEFACT

Account: NASA Astronaut Donald Pettit's 'Saturday Morning Science' (ISS Expedition 6, 2002/03).

Figure 1: Selection of video stills from Pettit's demonstration on gyroscopic spin stabilization using portable CD players and a torch on April 26, 2003 [from NASA]

Table 1: Inventory of objects and material re-appropriated by Pettit compiled from 22 items of onboard archive footage (NASA).

Items used or demonstrated in footage	
'barbie loaf' breads	Kapton tape
250ml culture flask	large plastic bag
Alka Seltzer effervescent tablets	long thin glass tube
aluminium cylinder container	Makita drill
baby bottle	multi purpose tool
blue t-shirt	packages
bolt	peanut butter
camera	plastic bags/ pouches
camera lens	plastic foil
candy corn	portable CD player
canned food	precision screw driver
cannula	scissors
compact disc	screws
chopsticks	small squirt tubes
chunks of orange peel	sodium chlorite crystals
clamps	soldering iron
copy of 'Understanding Engineering Thermo' ('rectangular solid')	squirt syringe tops
	straws
	sugar
crackers	syringes
drink bag	teabags
duct tape	tealeaves
ear phones	torch
egg, fresh	towels
egg, hardboiled	tracer particles
food colouring	tweezers
freeze dried coffee	Velcro
glue	viscoelastic fluid/ gel
honey	vitamin tablet