

# EVALUATION OF THE NEXT-GEN EXERCISE SOFTWARE INTERFACE IN THE NEEMO ANALOG

**Andrea Hanson, Ph.D.**

**JSC Exercise, Physiology & Countermeasures Lab**

Kent Kalogera, KBRwyle, JSC Exercise, Physiology & Countermeasures Lab

Aniko Sandor, Ph.D., KBRwyle, JSC Space Human Factors and Habitability

Marc Hardy, CEO and Co-Founder of Run Social

Andrew Frank, Run Social

Kirk English, Ph.D. JES Tech, JSC Exercise, Physiology & Countermeasures Lab

Thomas Williams, Ph.D. JSC Element Scientist, Human Factors & Behavior Performance

PI-Jeevan Perera, J.D., Ph.D., JSC Software, Robotics and Simulation

Science PI- William (Bill) Amonette, Ph.D., University of Houston – Clear Lake

# Background

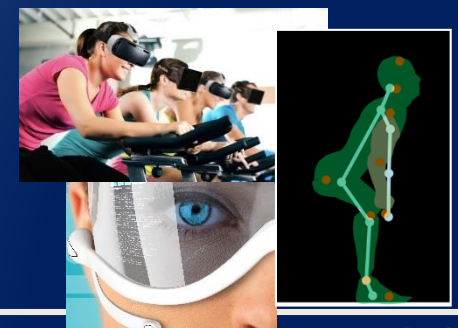
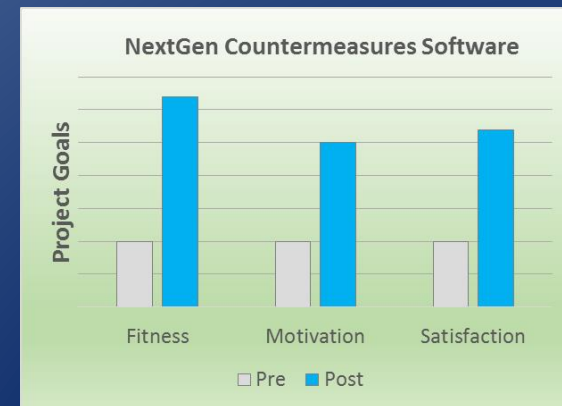


- **NSBRI funded research grant to develop the 'NextGen' exercise software.**

- Develop a software architecture to integrate instructional, motivational and socialization techniques into a common portal to enhance exercise countermeasures in remote environments.
- Increase user efficiency and satisfaction, and institute commonality across multiple exercise systems.
- Utilized GUI design principals focused on intuitive ease of use to minimize training time and realize early user efficiency.
- Project requirement to test the software in an analog environment.

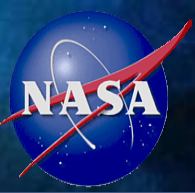
- **Top Level Project Aims**

- 1) Improve the usability of crew interface software to exercise CMS through common app-like interfaces.
- 2) Introduce virtual instructional motion training.
- 3) Use virtual environment to provide remote socialization with family and friends, improve exercise technique, adherence, motivation and ultimately performance outcomes.





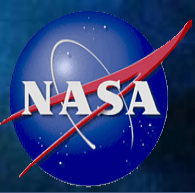
# Miniature Exercise Device- Second Generation (MED-2)



- The MED-2 is a small exercise device selected under the 2 x 2015 1E process to expedite fabrication and launching new International Space Station (ISS) hardware.
- The MED-2 will be used on the ISS as a test bed for understanding small exercise device capabilities and informing future Multi-Purpose Crew Vehicle exercise device designs.
- MED-2 is currently aboard the ISS.
  - First crew session planned for February 2017.
  - Valuable lessons learned from NEEMO21 evaluation provide direct benefit to ISS evaluation.

# NASA Extreme Environment Mission Operations

## NEEMO



- **The NEEMO analog provides:**

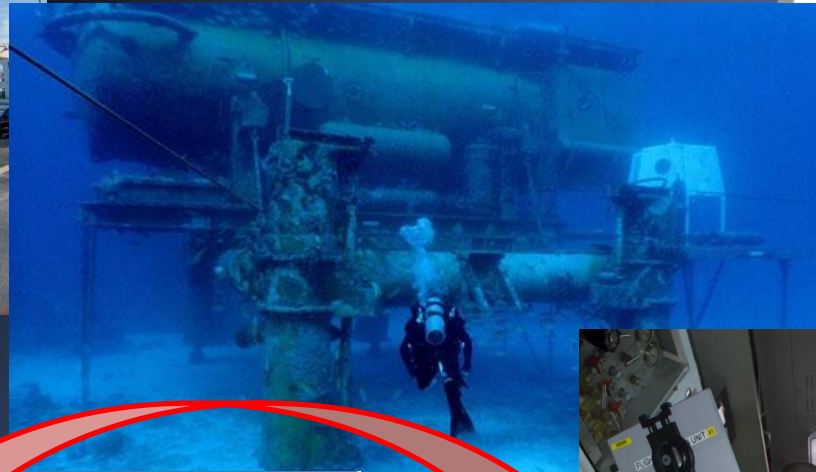
- A trained, international crew (astronauts and civilian), N=6, to carry out research objectives.
- Mission days fashioned after ISS work plan.
- A trained mission operations team in a functional Mission Control Room (Mission Director, Ops Lead, Schedule Lead, Capcom and use of flight-like communication tools and protocols, etc.).
- Opportunity for work-volume assessment in a small footprint habitat.
- A true extreme and remote test environment.
- Dry-run of in-flight protocols and procedures.
- **Overall one of the most valuable analog and flight readiness test facilities available.**





# Aquarius Reef Base

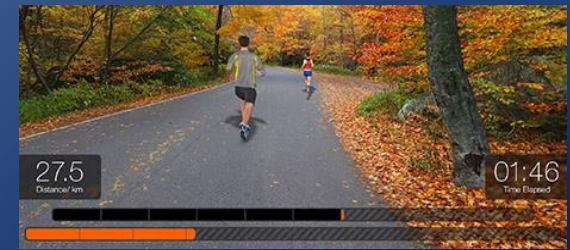
Aquarius is located ~9 miles south of Key Largo, FL at ~60 feet deep.



# NEEMO21 Goals

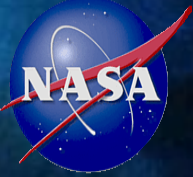


- Evaluate NextGen SW with the MED-2 exercise device to assess user efficiency and satisfaction.
  - User satisfaction surveys post sessions.
  - Usability testing software (Morae) records each screen session and allows assessment of user efficiency.
  - Test feasibility of using the virtual interface and training partner (Run Social) with a remote user.
  - Solicit feedback on use of MED-2 hardware.



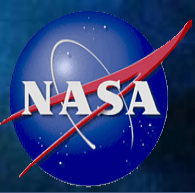


# Mission Control and NextGen Ops



	MD1	MD2	MD3	MD4	MD5	MD6	MD7	MD8
<b>Crew 1</b>		14:30-15:15 Strength		15:45-16:30 Aerobic		15:30-16:15 Strength-Aero		
<b>Crew 2</b>			14:45-15:30 Strength		16:30-17:15 Aerobic		14:30-15:15 Strength-Aero	
<b>Crew 3</b>			16:00-16:30 Strength		14:30-15:15 Aero-RunSocial		15:15-16:00 Strength-Aero	
<b>Crew 4</b>		15:15-15:45 Strength		14:30-15:15 Aero-RunSocial		16:15-17:00 Strength-Aero		
	MD9	MD10	MD11	MD12	MD13	MD14	MD15	MD16
<b>Crew 1</b>			15:00-15:45 Strength-Aero			15:15-16:00 Aero-RunSocial		
<b>Crew 2</b>		16:00-16:45 Strength-Aero			16:45-17:30 Aero-RunSocial			
<b>Crew 5</b>		15:15-16:00 Strength-Aero		14:30-15:15 Strength		14:30-15:15 Aero-RunSocial		
<b>Crew 6</b>			15:45-16:15 Strength-Aero	17:00-17:45 Strength	16:00-16:45 Aero-RunSocial			

# NEEMO21: Evaluation of NextGen Software on MED-2

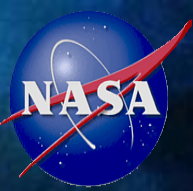


- NextGen software runs on a Microsoft Surface Pro platform.





# MED Login View



**NASA** Miniature Exercise Device

			
<a href="#">Behnken</a>	<a href="#">Bowen</a>	<a href="#">Du Toit</a>	<a href="#">Kernagis</a>
			
<a href="#">O'Griofa</a>	<a href="#">Maurer</a>	<a href="#">Wiseman</a>	<a href="#">Tech</a>

[? Overview Video](#) [Exit](#)

# Resistive MED View





O'Grifa

Logout

Exercise History

System Status

Help Videos

Prescription Exercises

#	Exercise Name	Load Resist.	Reps Dur	Sets
1	Deadlift	25	50	20
2	Deadlift	50	50	20
3	Deadlift	75	50	20
4	Deadlift	100	50	20
5	Aerobic Row	5	1	2
6	Aerobic Row	11	0.2	3
7	Aerobic Row	3	1	2
8	Aerobic Row	1	50	20

Mode

Manual

Prescriptions

Stop Exercise



## Miniature Exercise Device

Exercise in Progress  
08 Oct 2015 15:40:52

# Deadlift

Resistive  
Prescription Mode

Load Setting (5-400 lbs)

# 50

Actual Load (lbf): 51

+

-

Repetitions

# 4

/ 50

Sets

# 0

/ 20

Exercise Review

### Rep Thresholds

Reset Thold



Elapsed Time

# 01:51

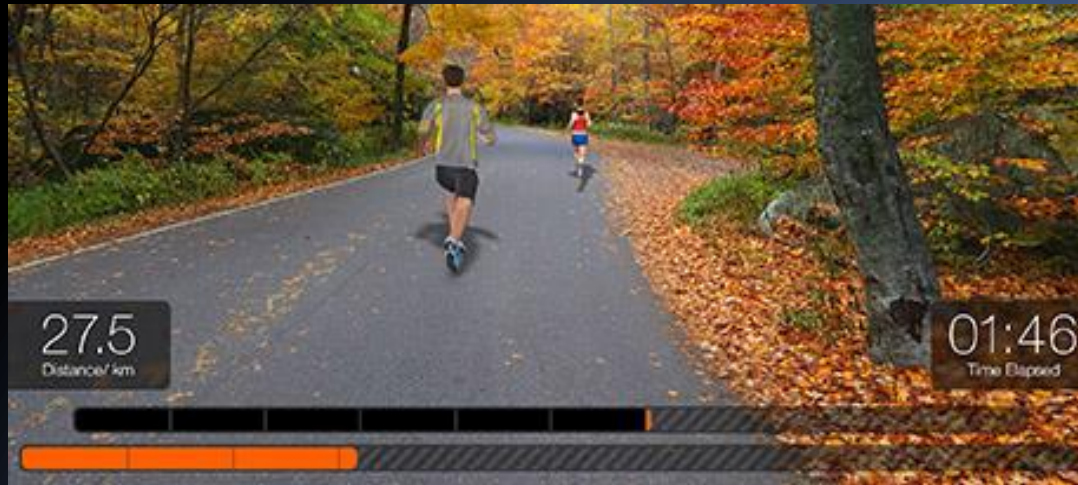
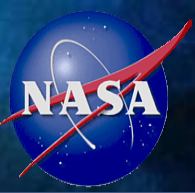
Heart Rate

# 120

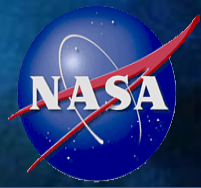
bpm



# Run Social



- RunSocial.com actual environments and socialization techniques will be evaluated as an integrated feature to the new CMS software system.
- These features will enable crew members to select daily running/rowing virtual environments with changing landscapes that match the exercise prescription provided by the astronaut strength and conditioning coaches (i.e. speed, etc).
- For NEEMO21 evaluation, upright rowing will be substituted for running, and you will be connected to a virtual training partner located topside.
  - RunSocial displayed on iPad, not the Surface Pro.



## Morae® Analysis (~20 hours of video)

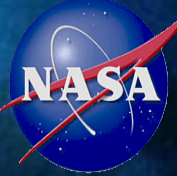
- Allows you to record and remotely observe user interactions (navigation through software screen only) and audio recording for analysis of in-session commentary.

### Key Feedback Captured

- **Connectivity issues** sometimes resulted in failure to transfer exerciser protocols, pop-up of post-session survey, and transfer of data files.
- Revealed the **exercise demonstration videos** were in a bad location.
- It was not clear how to **navigate through the Rx list**.
- The Bluetooth **Heart Rate Monitor was difficult to pair**.
- **Server issues** disrupted synchronization of data files.
- Exercise **threshold settings** need higher tolerance to capture all repetitions performed.
- Great **crew-to-crew training** and shared experience.
- Get rid of need to **select start/stop** at each new set.
  
- *“This is a pretty legit workout!”*
- *“You have to hit end/start exercise every time and I found that very annoying.”*
- *“That doesn’t seem to work.” (paired with screen interaction provided flag on specific issue-selecting exercise in list vs using navigation arrows)*



# System Usability Assessment



## Feedback from Post-Session Survey

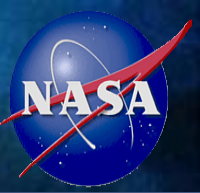


- 50% response rate (11/22).
- Server disruptions resulted in cancelation of survey at end of session. Fixed with sw update.
- Generally an overall positive response on system usability and utility.

## • Post-Session Survey Written Feedback

- **Label cables.** Instructions were not clear in setup. Error screens and flow were not accounted for.
- **Setup was cumbersome.** Once I got exercising, most things were intuitive. Not sure why I need to select stop exercise and start in between each sets that should be automatic
- First time user with limited training, there **should be pictures or video to demonstrate how to do each exercise properly** with this device. The help videos are empty and there are no images in the referenced procedure.
- If I skip an exercise, I still have to scroll past it each time I finish a subsequent exercise. **The next exercise in the list should be the default.**
- Heart rate monitor is easily paired but did not display anything. **No joy with a 2nd heart rate monitor.**
- The **exercise prescription should follow one after the other** with a 30-60 second break between sets.

# Crew Debrief & Lesson Learned



## Safety Notes:

- Need to review the mechanism for emergency release of a loaded bar.
- Crew reported it was difficult to get a loaded bar in place for front squat.

## Actions:

- Added caution block to ISS Procedures alerting crew to the fact that the cable will pull in if/when released.
- Demonstration and familiarity with the cable release action will be added to the ground training session.
- Crew are reminded exercise in zero-gravity is different from ground training, and to not perform any exercise they feel poses a safety concern.

## GUI Notes:

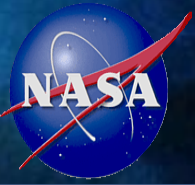
- Crew provided feedback on the desire to see the software auto iterate between sets of the same exercise.

## Actions:

- Videos can be sent up at any time without making changing to the flight software.
- All videos that demonstrate exercise form will be included in the 'Exercise Review' button, and procedures note how to find these videos.
- The button 'Exercise Review' will be renamed to 'Exercise Video' to alleviate confusion over where to locate the exercise videos.

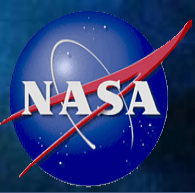


# Crew Debrief & Lesson Learned cont.



- Additional vetting of exercise procedures in an ISS analog environment resulting in enhanced ISS MED 2 procedures.
- Redefined scheduling of hardware setup and teardown timeline. NEEMO analog environment/crew consistently showed hardware setup and teardown took longer than originally planned.
- Allow more time for operations in timeline/PlayBook (most of our sessions were not completed within allocation – set up and tear down took much longer than expected, probably help videos would have been much more useful in make the process more efficient).
- Identified shortcoming of the MED 2 heart rate monitor Bluetooth pairing with the Microsoft Surface Pro 3.
- Additional training/simulation opportunity for MED 2 ISS ops and engineering support teams.
- Software development goal is to minimize training needs, through an intuitive App-like interfaces. NEEMO crew commented that the SW was intuitive and easy to use. Continue to assess how this goal has been achieved.
- Leverage video help screens vs textual/graphical help files or crew procedures (use short targeted videos) - we didn't have enough of these videos pre-developed.
- Highlighted need for flexibility to change operational parameters and configurations, setups, questionnaires remotely (already incorporated).

# Acknowledgments



- This work supported by the National Space Biomedical Research Institute through NASA NCC 9-58.

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Science PI- William (Bill) Amonette, Ph.D., University of Houston – Clear Lake



## NASA JSC MED-2 Support Team

Stu Donnan

Austin Lovan

Henry Ong

## NEEMO Management Office

William Todd

Marc Reagan

Jason Pofferberger

NEEMO21 Mission Control Team

FIU Aquarius Reef Basin Office

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Matthias Maurer – ESA Astronaut

Megan McArthur – NASA Astronaut

Marc O’Griofa – Teloregen/VEGA/AirDocs

Reid Wiseman – NASA Astronaut