NHERI@UTexas Virtual Workshop

Welcome

Date : Wednesday, December 14, 2022

Time : 1:00 - 3:00 pm (CST)

NHERI@UTexas Virtual Workshop

Wednesday, December 14, 2022, 1:00 - 3:00 pm (CST)

- 1:00 pm – Welcome
- 1:05 pm – Introduction of NHERI@UTexas Facility (Prof. Kenneth Stokoe, University of Texas at Austin)
- 1:20 pm – Field Trials with NHERI@UTexas T-Rex to Evaluate Microbially Induced Desaturation for Silt Liquefaction Mitigation (Prof. Diane Moug, Portland State University)
- 1:40 pm – Use of Large Mobile Shakers in Bridge Evaluations: Structural Identification, and Assessment of Dynamic Soil-Structure Interaction Effects and Unknown Foundations (Prof. Nenad Gucunski, Rutgers University)
- 2:00 pm – Recent Developments in Subsurface Imaging using Distributed Acoustic Sensing (DAS) and NHERI@UTexas Large Mobile Shaker Trucks (Lead Engineer. Peter Hubbard, FiberSense and Prof. Brady Cox, Utah State University)
- 2:20 pm – Q&A

NHERI@UTexas
Large Mobile Shakers
NSF Shared-Use Experimental Facility

Presented by
Dr. Kenneth H. Stokoe, P.E., NAE
Professor, UT Austin, Dept. of Civil, Architectural, and Environmental Engineering
Dr. Brady R. Cox, P.E.
Professor, Utah State University, Dept. of Civil and Environmental Engineering

December 14, 2022

Natural Hazards Engineering Research Infrastructure

7 Experimental Facilities with Large-Scale Equipment
1 Cyberinfrastructure Facility for Archiving and Sharing Data
1 Computational Modeling/Simulation Center
1 Post-disaster Rapid Response Facility
1 Network Coordination Office

PURDUE UNIVERSITY
Network Coordination Office
NSF Award #2129782

UNIVERSITY OF COLORADO BOULDER
CONVERGE
Social Science/Interdisciplinary Resources
NSF Award #1841338

UNIVERSITY OF CALIFORNIA, BERKELEY
SimCenter
Computational Modeling and Simulation
NSF Award #2131111

UNIVERSITY OF WASHINGTON
Natural Hazard
Reconnaissance (RAPID) Facility
NSF Award #2130997

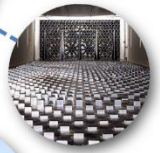
UNIVERSITY OF TEXAS, AUSTIN
DesignSafe
Community Cyberinfrastructure
NSF Award #2022469

OREGON STATE UNIVERSITY
Large Wave Flume and
Directional Wave Basin
NSF Award #2037914

LEHIGH UNIVERSITY
Large-Scale Multi-Directional
Hybrid Simulation Testing
NSF Award #2037771

UNIVERSITY OF TEXAS, AUSTIN
Mobile Field Shakers
NSF Award #2037900

UNIVERSITY OF FLORIDA
Boundary Layer Wind Tunnel
NSF Award #2037725



UNIVERSITY OF CALIFORNIA, DAVIS
Geotechnical Centrifuges
NSF Award #2037883

FLORIDA INTERNATIONAL UNIVERSITY
Wind Simulation
NSF Award #2037899

UNIVERSITY OF CALIFORNIA, SAN DIEGO
Large High-Performance Outdoor Shaker Table
NSF Award #2227407

NICHE
Planning for the new, shared-used National
Full-Scale Testing infrastructure for Community Hardening
in Extreme Wind, Wave and Surge Events
NSF Award #2131961

For more information, visit the
NHERI DesignSafe website: DesignSafe-ci.org

Engineering for Civil Infrastructure (ECI)

CONTACTS

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Joy M. Pauschke	ECI@nsf.gov	(703) 292-7024	

Principal Investigators are encouraged to leverage NSF's investments in the Natural Hazards Engineering Research Infrastructure (NHERI) experimental, computational modeling and simulation, and data resources (https://www.designsafe-ci.org/) in their research to accelerate advances needed for reducing the impacts of natural hazards..

- NHERI equipment can be used with funding from any NSF program
- NHERI equipment can be used at higher rates for non-NSF funding (including industry)

NHERI@Utexas Project Team

Director/PI
Kenneth Stokoe
Prof., UT Austin

Co-PI
Brady Cox
Prof., Utah State Univ.

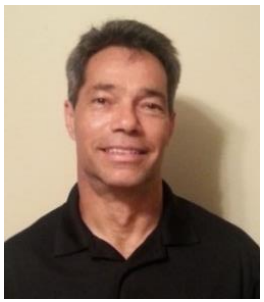
Co-PI
Patricia Clayton
Assoc. Prof., Wake Forest Univ.

Co-PI
Robert Gilbert
Chair & Prof., UT Austin

Operations Manager
Sungmoon Hwang
UT Austin

IT/Cybersecurity
Robert Kent
UT Austin

Project Support & NSF Liaison
Farnyuh Menq
UT Austin



Hydraulics Technicians
Andrew Valentine and
Elido Ruiz
UT Austin

Mobile Shaker Specialist
Cecil Hoffpauir
UT Austin

NHERI@UTexas Equipment Overview

- Five (5) large, servo-hydraulic, mobile shaker trucks
- Various support vehicles and trailers
- A wide array of instrumentation for recording vibration, force, and pore water pressure

T-Rex (Tri-axial Shaker)
- Off-road buggy;
- 32 ft long, 8 ft wide, weight = 64,000 lbs
- Three vibrational orientations
- Push-button transformation of shaking orientation
- Shear mode Peak Force = 30,000 lbs
- Vertical mode Peak Force = 60,000 lbs

Liquidator (Low Frequency Shaker)
- Off-road buggy;
- 32 ft long, 8 ft wide, weight = 72,000 lbs
- Two vibrational orientations
- One day shop transformation of shaking orientation
- Shear mode Peak Force = 20,000 lbs
- Vertical mode Peak Force = 20,000 lbs

Thumper (Urban Shaker)
- Built on a International 4300 truck;
- 27 ft long, 8.5 ft wide, weight = 24,800 lbs
- Three vibrational orientations
- Four hours field transformation of shaking orientation
- Shear mode Peak Force = 6,000 lbs
- Vertical mode Peak Force = 6,000 lbs

Raptor (Mid-Size Shaker)
- Highway legal truck
- 32 ft long, 8 ft wide, weight = 41,200 lbs
- Vertical mode Peak Force = 27,000 lbs

Rattler (Horizontal Shaker)
- Off-road truck;
- 29 ft long, 8.5 ft wide, weight = 54,500 lbs
- Shear mode Peak Force = 30,000 lbs

Big-Rig
- 26 wheeler tractor-trailer rig for shipping T-Rex, Liquidator, and Rattler
- Overweight permit required

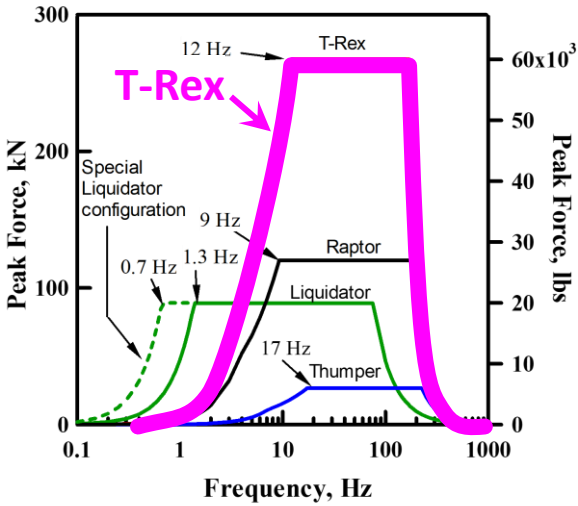
Fuel-Supply Truck
- Carries diesel fuel for T-Rex, Liquidator, and Rattler in the field
- provides a working platform for maintenance and CPT tests

Instrumentation Van & Trailer
- A customized Chevrolet cargo van provides an air-conditioned workspace
- A 8 ft by 16 ft cargo trailer provides additional working and storage space

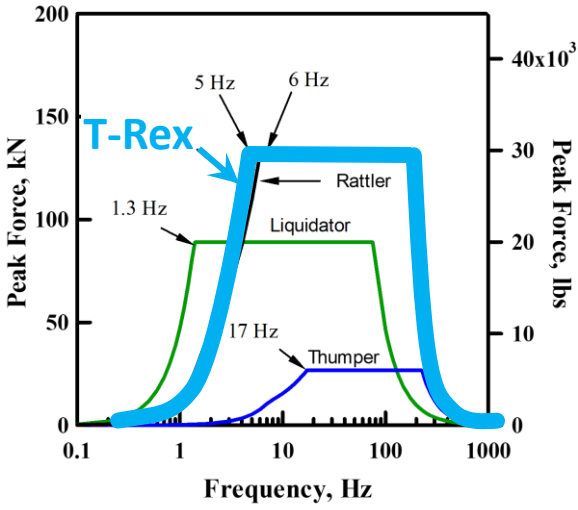
Hydraulic Cylinder with Adjustable Platform
- Mounted at the rear of T-Rex
- Platform for installing and retrieving liquefaction, CPT, and seismic CPT sensors

T-Rex

- Tri-axial shaker
- Push-button transformation of shaking orientation
- 32 ft long, 8 ft wide, Wt. = 64,000 lbs
- Only operating tri-axial vibroseis we are aware of in the world



Vertical force output



Horizontal force output

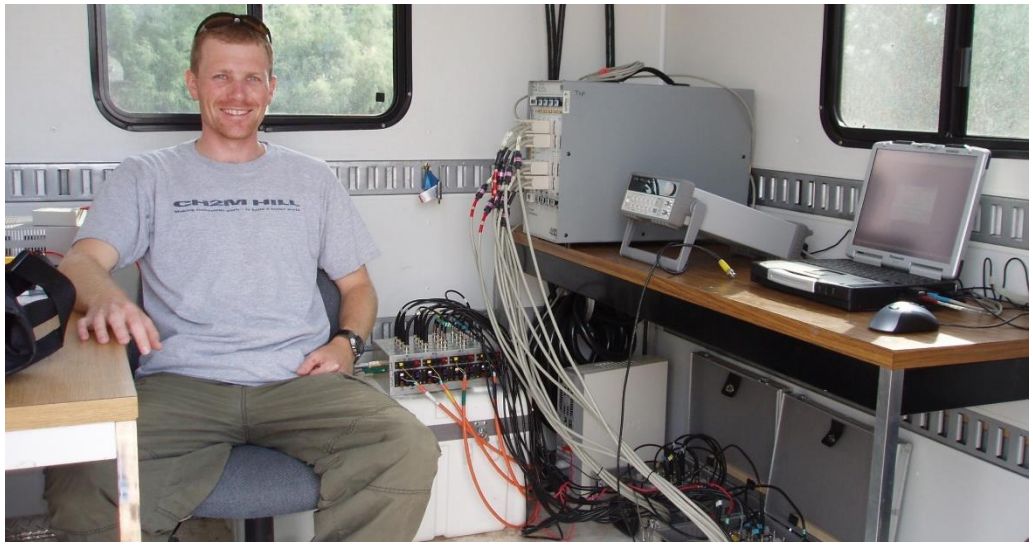
T-Rex – Horizontal Shaking

Support Vehicles

Hawaii

Provide fuel, storage, and workspace in the field

Instrumentation – Data Acquisition (DAQ)



72-channel VXI DAQ

- 24 bit digitizer
- Up to 50 kHz sampling rate
- Real-time frequency domain capabilities

↓

168 channels of DAQ

↑

96-channel Data Physics DAQ

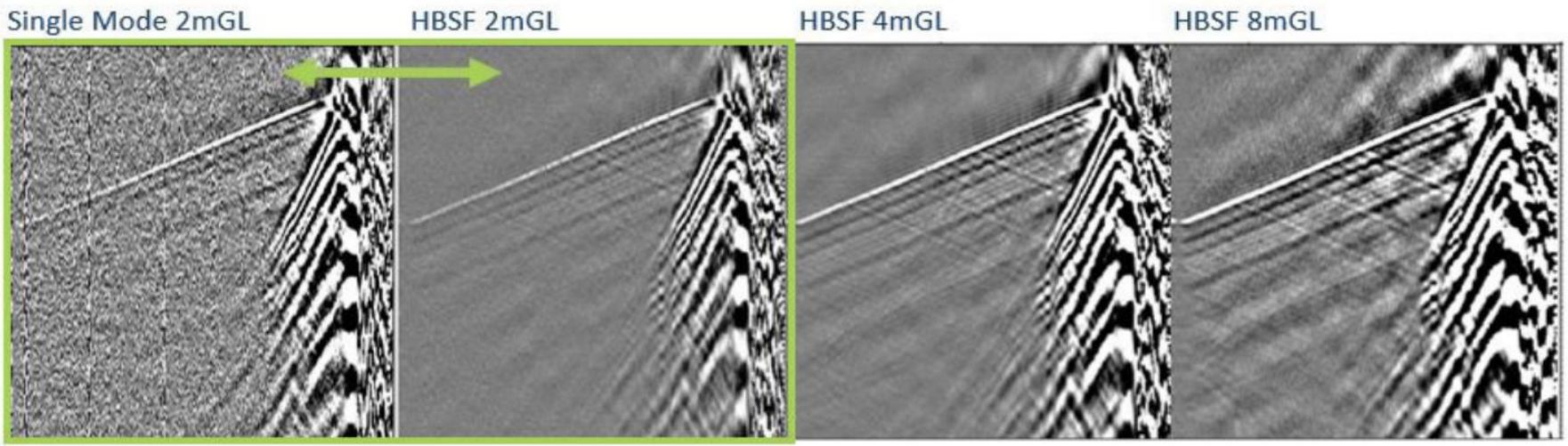
- 24 bit digitizer
- Up to 200 kHz sampling rate
- Real-time frequency domain capabilities

Instrumentation – DAS Interrogator

- **New in 2021**
- OptaSense ODH4 DAS Interrogator
- Distributed Acoustic Sensing (DAS); fiber optic sensing
- Capable of measuring with ANY fiber from ANY vendor (single mode, multi-mode or enhanced high backscatter)
- Sample rate up to 100 kHz

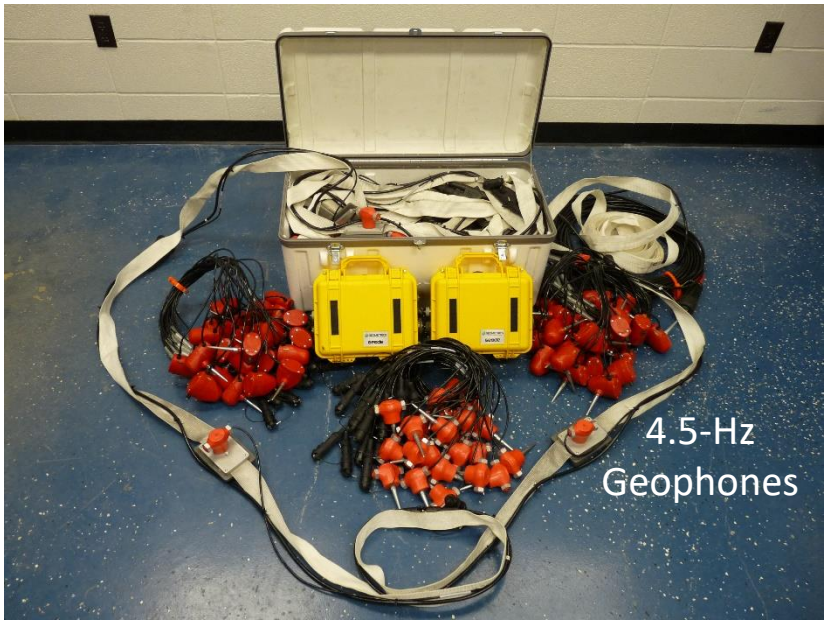
OptaSense®
A QINETIQ company

High Backscatter Single Fiber 2m Gauge Length



Instrumentation – Geophones

- 109, 1-Hz Geophones (85 vertical & 24 horizontal)
- 15,000 ft of twisted, shielded-pair cable

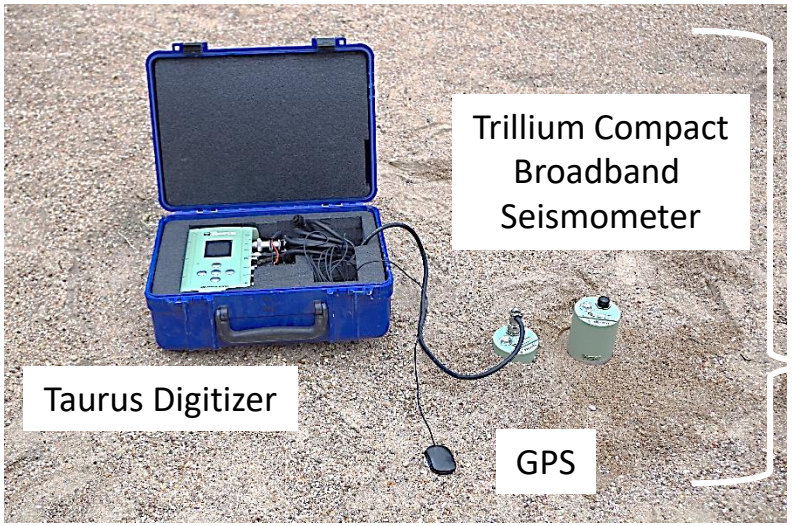


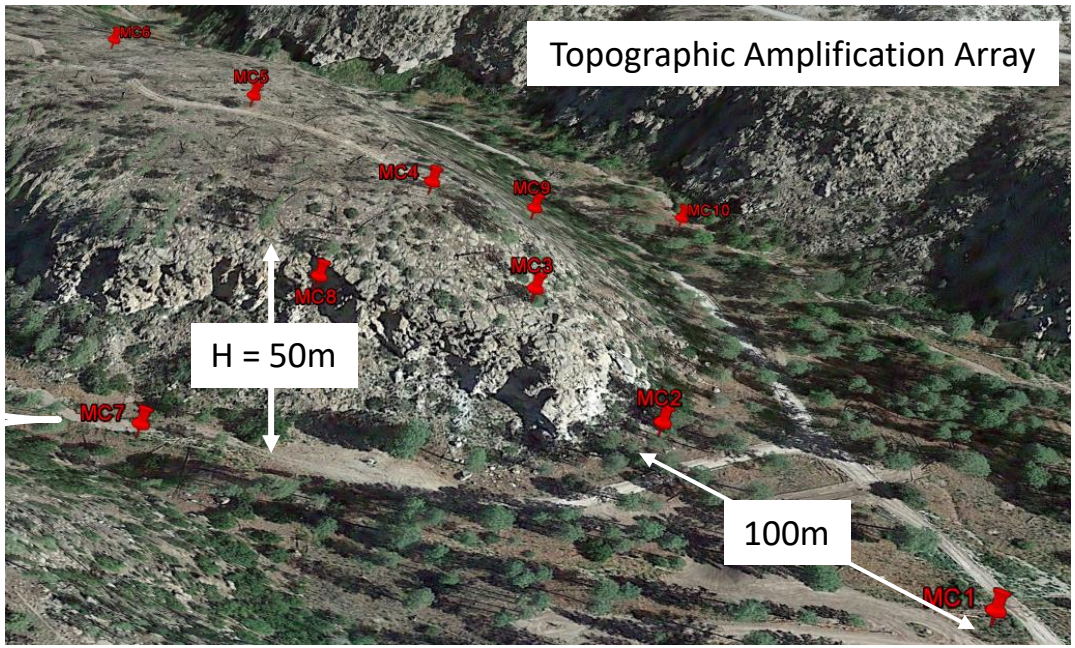
- 196, 4.5-Hz Geophones (98 vertical & 98 horizontal)
- Refraction cables (24-channels, 4 @ 2m & 4 @ 5m)
- Towable landstreamer (24-sleds)
- 2, 24-channel Geode seismographs

Instrumentation – 3C Nodal Geophones

- **New in 2021**
- <u>100, SmartSolo IGU-16HR 3C nodal stations</u>
- 3-component
- 5-Hz geophones
- 24 bit ADC
- GPS synchronized
- Size: 103mm (L) x 95mm (W) x 150mm (H)
- Weight: 1.7kg

Instrumentation – Broadband Seismometers

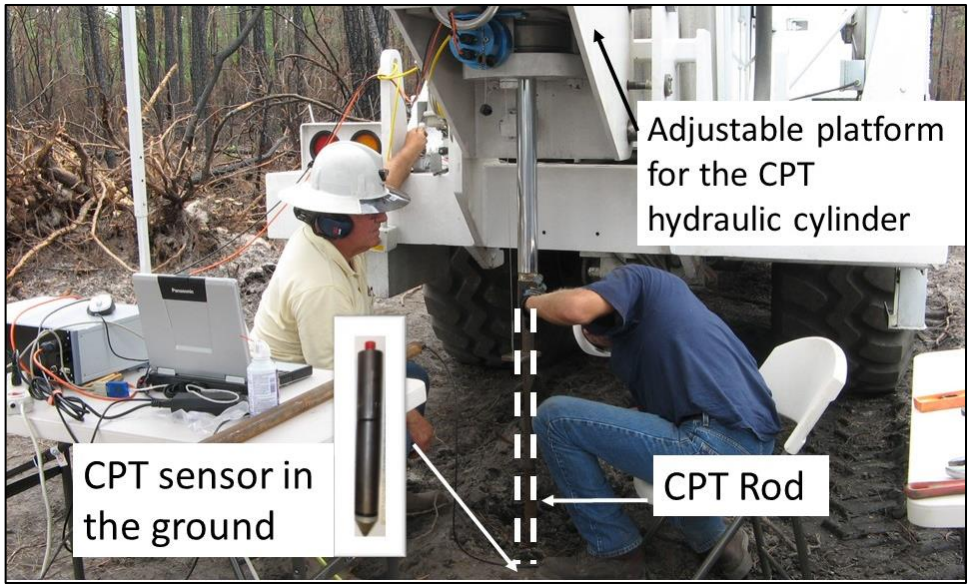




20, Nanometrics Broadband Seismometer Stations

- 3-component
- GPS synchronized
- 10, 120-sec period and 10, 20-sec period Trillium Compact seismometers
- 10, Taurus and 10, Centaur digitizers (3-component, 24 bits)
- Structural and Geotechnical applications (flat response 0.01 to 100 Hz)

Instrumentation – CPT and Liquefaction Sensors



Direct-Push Sensors

Cone Penetrometers

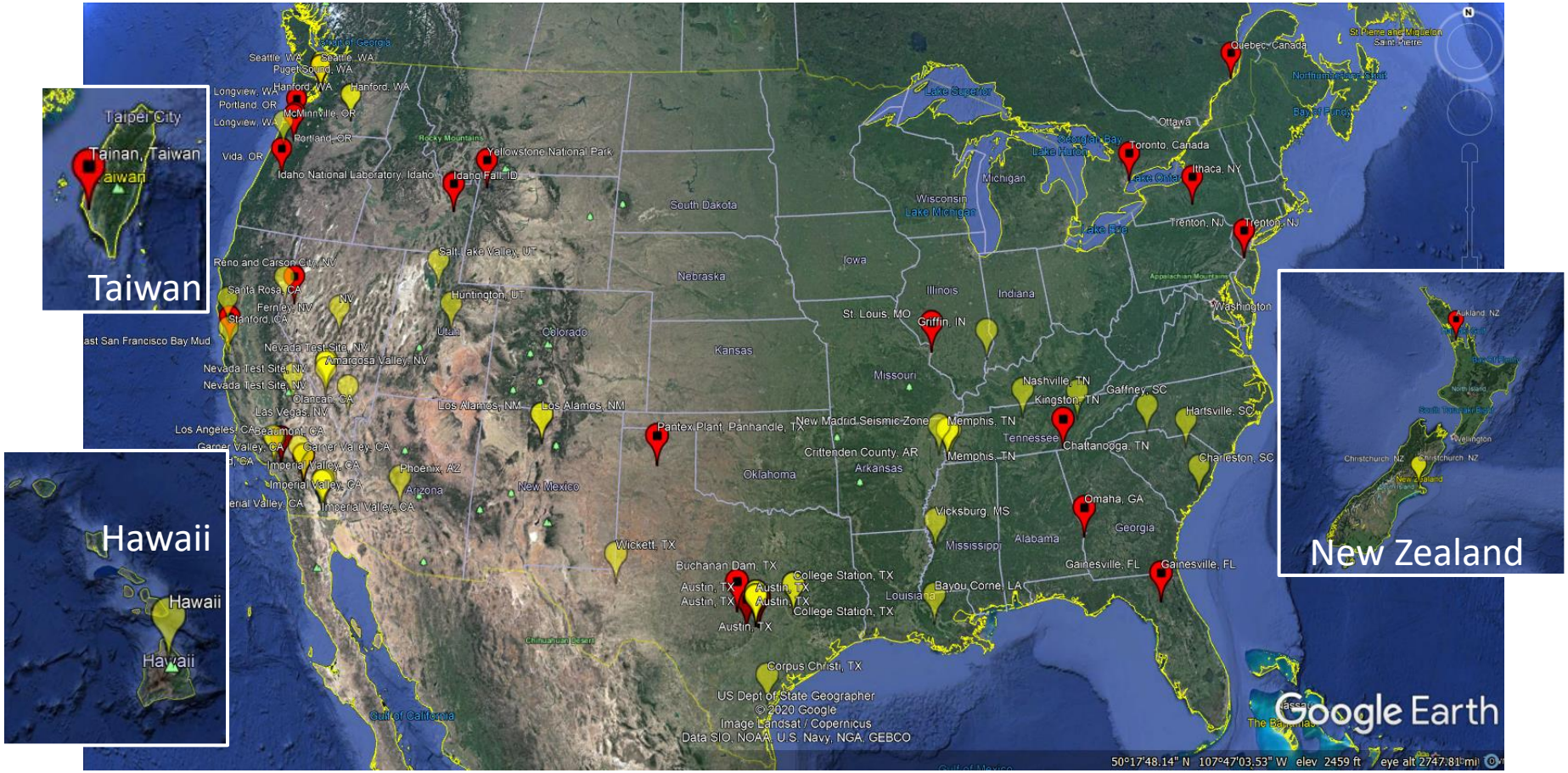
- Standard CPT
- Seismic CPT
- 4 different cones

Liquefaction Sensors

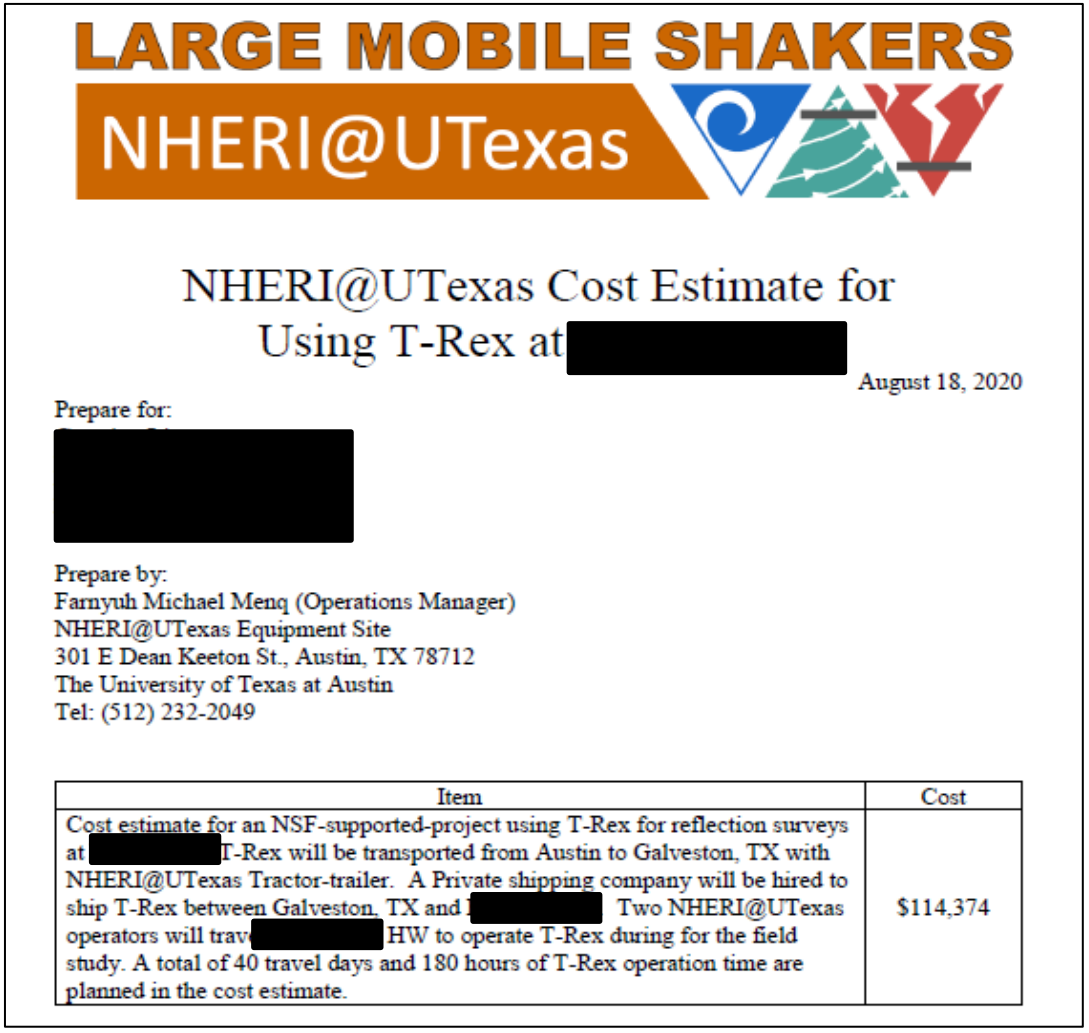
- Custom built
- Tri-axial MEMS accelerometers
- 2D or 3D geophones
- Pore water pressure transducers

“Have shaker trucks, will travel…”

- 55 Projects 2003 - 2014 (NEES, Shared-use, Industry/Gov.)
- 26 Projects 2016 - 2020 (NHERI, Shared-use, Industry/Gov.)



Example: Cost Estimate for a Recent Research Proposal (Testing at an Attractive Island)



LARGE MOBILE SHAKERS

NHERI@UTexas

NHERI@UTexas Cost Estimate for Using T-Rex at [redacted]

August 18, 2020

Prepare for:

[redacted]

Prepare by:
Farnyuh Michael Menq (Operations Manager)
NHERI@UTexas Equipment Site
301 E Dean Keeton St., Austin, TX 78712
The University of Texas at Austin
Tel: (512) 232-2049

Item	Cost
Cost estimate for an NSF-supported-project using T-Rex for reflection surveys at [redacted] T-Rex will be transported from Austin to Galveston, TX with NHERI@UTexas Tractor-trailer. A Private shipping company will be hired to ship T-Rex between Galveston, TX and [redacted] Two NHERI@UTexas operators will trav[redacted] HW to operate T-Rex during for the field study. A total of 40 travel days and 180 hours of T-Rex operation time are planned in the cost estimate.	$114,374

Total Equipment Fuel Cost: $4,660

Travel Cost: $23,000

Ship T-Rex on a boat: $44,500

Overhead: $42,214

Total Cost: $114,374

(low)

Additional Information & Proposal Help

- Dr. Kenneth Stokoe (PI) k.stokoe@mail.utexas.edu
- Dr. Brady Cox (co-PI) brady.cox@usu.edu
- Dr. Patricia Clayton (co-PI) claytonp@wfu.edu
- Dr. Sungmoon Hwang (Operations Manager) sungmoon@utexas.edu

- NHERI@UTexas website at www.designsafe-ci.org
  - Webinar slides & updated budgetary info will be posted