Nautilus Technologies

Remote Pinpoint Leak Detection
and process optimization technologies

Michael David Nash, Ph.D.
President & Chief Executive Officer

Leak Detection: Gas Pipelines

- Requires no modifications to existing pipelines
- Detect leaks at a distance of 6 miles and more
- Can detect leaks less than 0.1 percent of flow volume
- Constant monitoring with automatic alert system
- Smart system pinpoints leak for rapid response

Nautilus Technologies' leak detection system licensed to ProFlex, LLC

Licensed to Proflex, LLC

- Equipment fabricated by Lime Instruments
- On track for large-scale implementation, Fall 2019

Successful Tests

- Kinder Morgan
- Apache
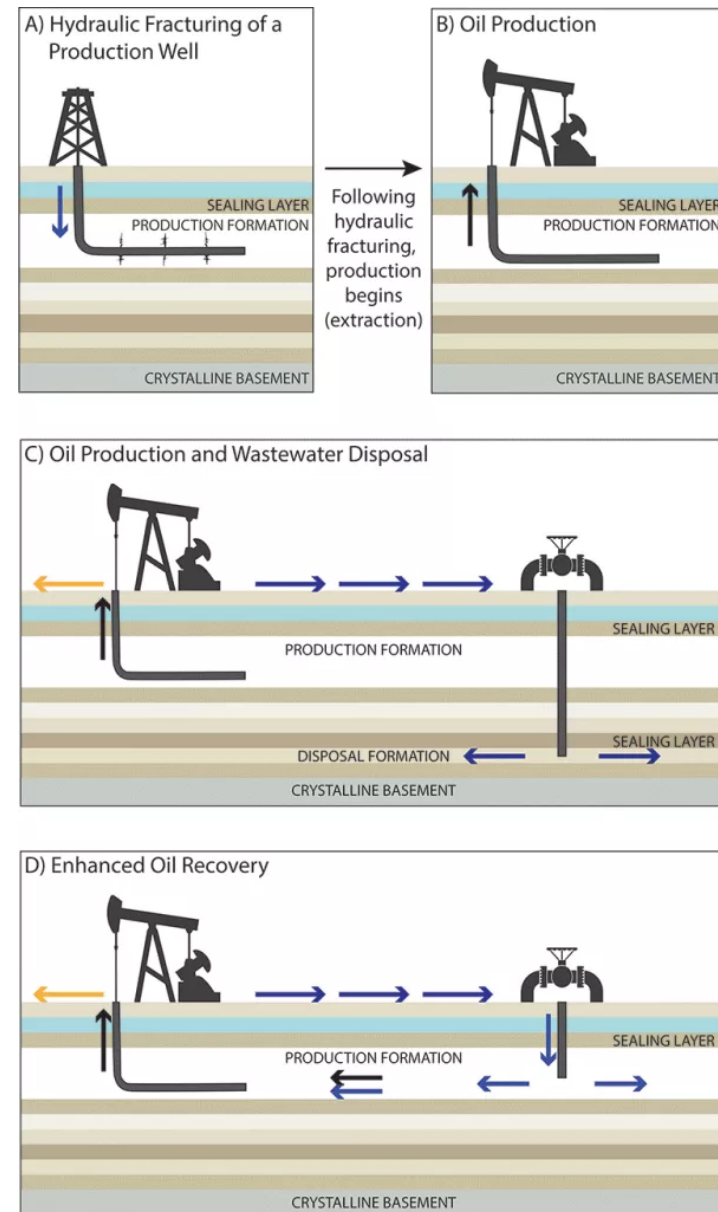- Kosmos
- BP (global)
- Shell
- Chevron
- QEP
- Cantium

Scheduling trials
- Enbridge
- BP (global)

NEW PRODUCT: AVAILABLE FOR LICENSING

New Product / Process Optimization: Water Disposal, EOR, and Avoiding Induced Seismicity

- New system with innovative devices and improved sensors
- Pinpoint precision
- Patent-pending "self-healing"
- Can identify gas locks and corrosion-created integrity issues and blockages
- Smart injection to avoid induced seismicity

A) Hydraulic Fracturing of a Production Well

SEALING LAYER
PRODUCTION FORMATION

CRYSTALLINE BASEMENT

Following hydraulic fracturing, production begins (extraction)

B) Oil Production

SEALING LAYER
PRODUCTION FORMATION

CRYSTALLINE BASEMENT

C) Oil Production and Wastewater Disposal

SEALING LAYER
PRODUCTION FORMATION

DISPOSAL FORMATION
SEALING LAYER
CRYSTALLINE BASEMENT

D) Enhanced Oil Recovery

PRODUCTION FORMATION
SEALING LAYER

CRYSTALLINE BASEMENT

Developed by Nautilus Technologies

Efficiency and Integrity Enhancement:
Gas Gathering, Gas Conditioning, Integrated Systems

1	2	3	4	5
Requires no alterations to existing pipelines	Detect integrity issues at a distance of 6 miles and more	Can detect leaks less than 0.1 percent of flow volume	Constant monitoring; automatic alert system; integrates with water disposal	Smart system pinpoints issues for Patent-pending "self-healing"

Main crude oil pipeline

Main product

Single-Side Leak Detection System

• What's unique? Can detect and locate leak by installing the system in the outlet only

• Put it at the outlet, and it can tell you exactly where your leak is upstream, and how large it is

• Extremely useful in offshore or deepwater settings

• Also useful in downhole systems; could enable remedial actions and pinpoint where to put a sleeve or repair

Real Time 3D Mapping that Identifies Activity and Calculates its Location

- Gathers acoustical information– when it hits the microphones, it calculates the point of origin

- Passive system (does not require anything generating sounds or lasers, etc.)

- Airborne is easier for calculations, but it can be used in water, soil, rock

- Any noise that hits the sensors, it uses the time differentiation to make a calculation thousands of times a second

- Point cloud generate

- Different positions of sensors

When a material fails, it is never silent

- Set up a sensor array

- The sensors have to touch the tank, pipe, shell, skin, etc.

- If there is a failure it will immediately detect it and calculate where

- Solar panels / battery operated

Security Application for
Real Time 3D Mapping that Identifies
Activity and precise Location

- Warehouses

- Offices

- Storage areas

- Can be used in a "lights-out" automated / robotic warehouses, etc; primary monitoring and will increase safety, efficiency, and formulate responses to accident
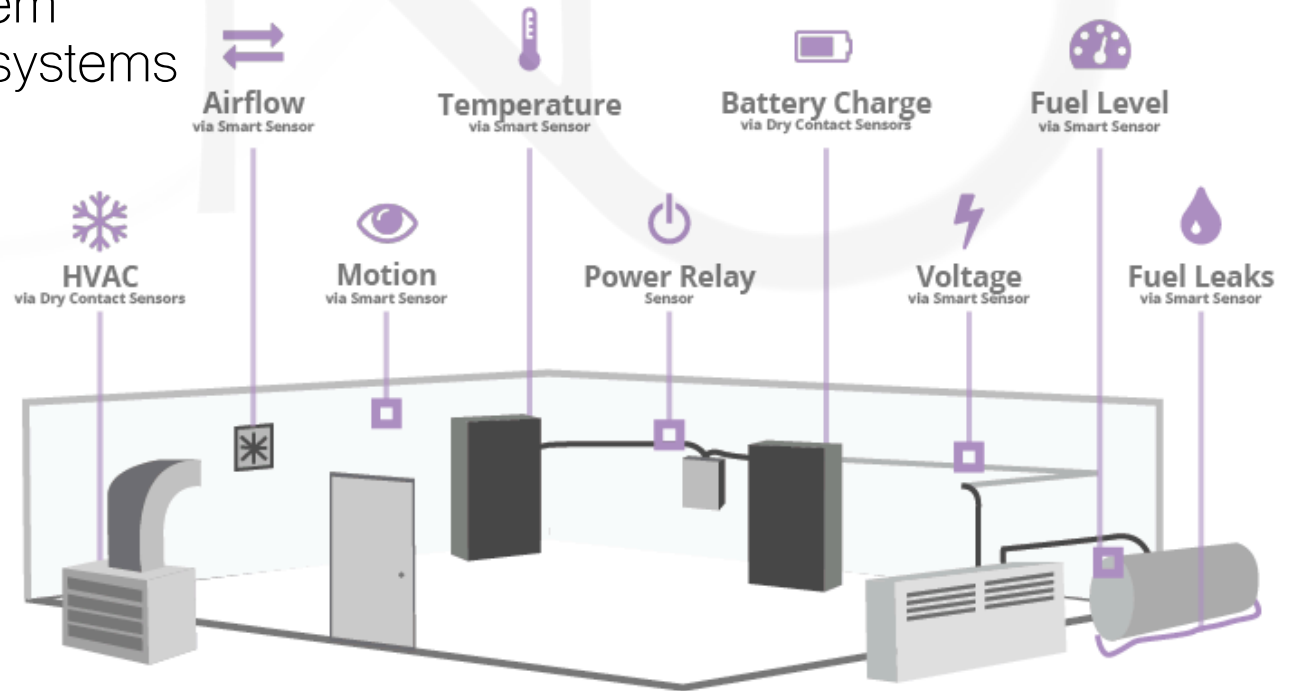
"Self-Healing"
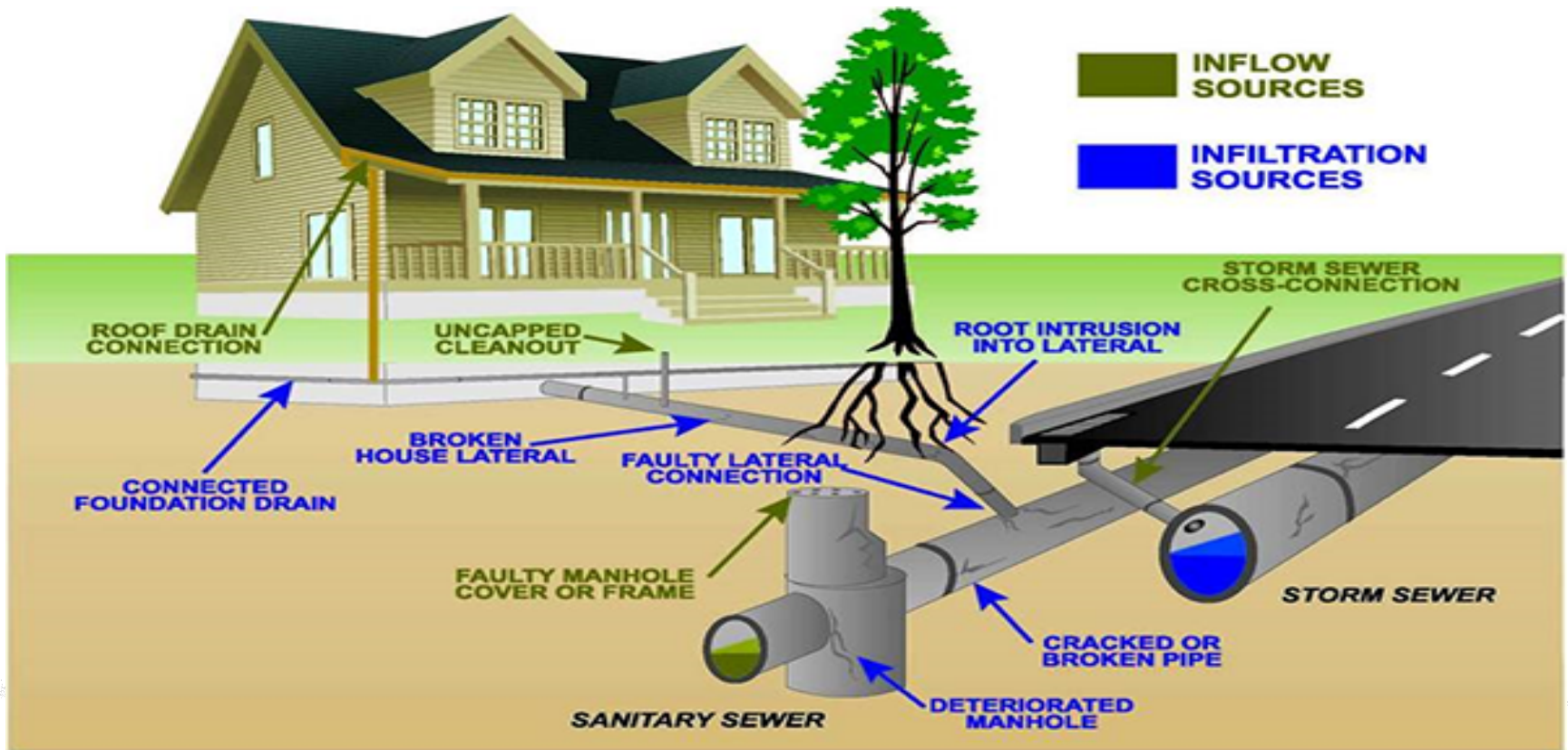# Automated Intervention:
The Next Frontier

- Connects with the "incident" intervention system

- Using the information (pinpointed location and definition of the leak, failure, rupture, or corrosion thinning) can respond with automated interventions

- This is possible now, thanks to the accuracy of the leak detection systems (the single-side leak detection and the 3D mapping)

Oilfield Security Systems

New sensors / system incorporating smart systems and analytics

- Anti–theft
- Safety
- Performance
- Optimization
- Efficiency

- Predictive
- Forensics

Airflow
via Smart Sensor

Temperature
via Smart Sensor

Battery Charge
via Dry Contact Sensors

Fuel Level
via Smart Sensor

HVAC
via Dry Contact Sensors

Motion
via Smart Sensor

Power Relay
Sensor

Voltage
via Smart Sensor

Fuel Leaks
via Smart Sensor

INFLOW SOURCES

INFILTRATION SOURCES

STORM SEWER CROSS-CONNECTION

ROOF DRAIN CONNECTION

UNCAPPED CLEANOUT

ROOT INTRUSION INTO LATERAL

BROKEN HOUSE LATERAL

FAULTY LATERAL CONNECTION

CONNECTED FOUNDATION DRAIN

STORM SEWER

FAULTY MANHOLE COVER OR FRAME

CRACKED OR BROKEN PIPE

SANITARY SEWER

DETERIORATED MANHOLE

Remote Pinpoint Leak Detection**PLUS**:
Upcoming Installations in City of Houston Waterworks

PARTNERSHIP FOR SAFE WATER

SIEMENS

- Can detect ruptures in residential water supply
- Requires no modification to system
- Constant monitoring; instant alert system
- Can pinpoint the location, relative intensity of the leak and the flow
- Can include "self-healing" feature
- Sub-licensed to Siemens for water utility leak monitoring
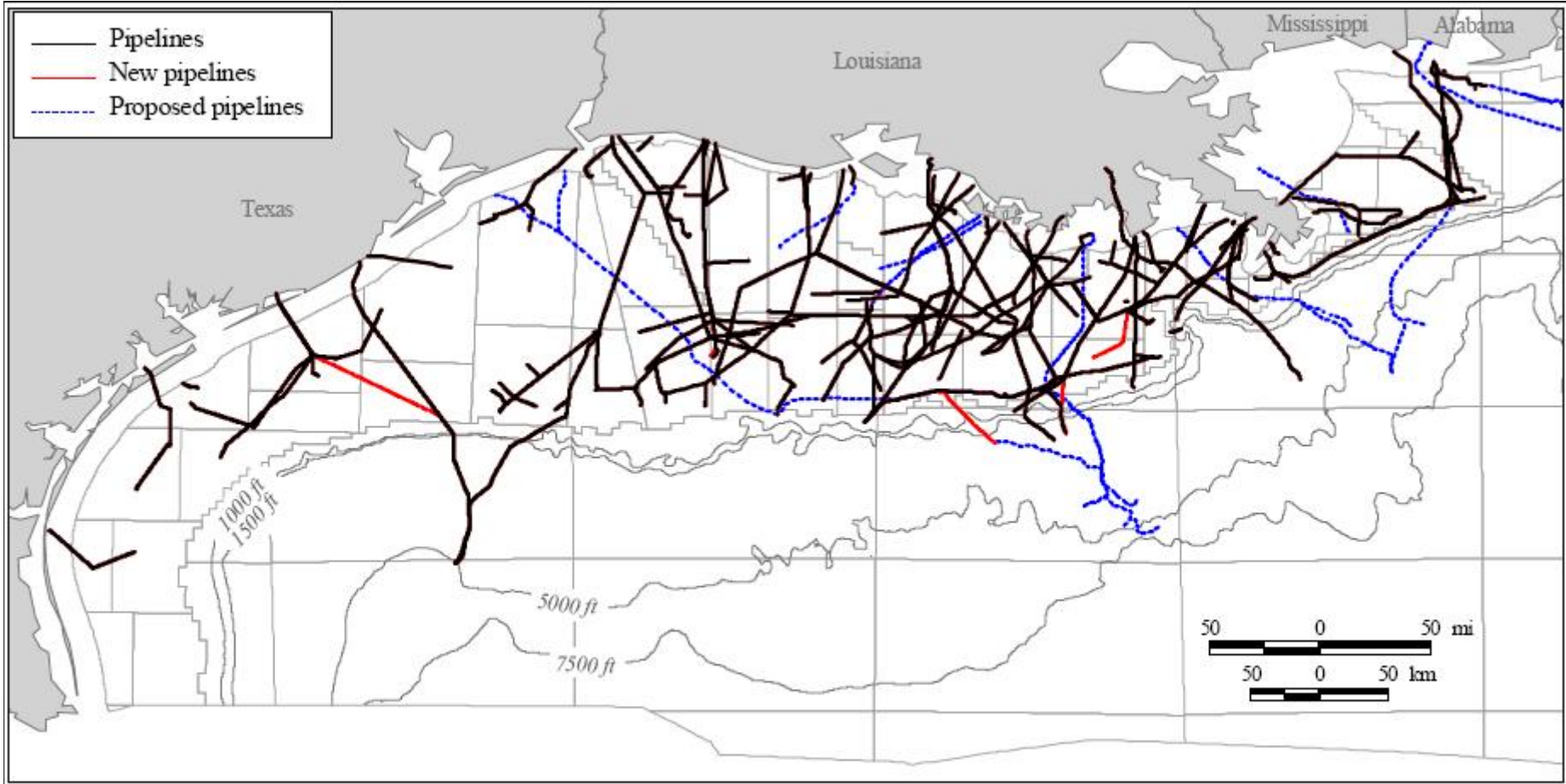
Offshore pipelines, gas gathering, gas conditioning integrity integration

- Offshore pipeline and gas gathering systems
- Integrates with Underwater Autonomous Vehicles & Robots
- Shallow: new and old gathering and conditioning systems
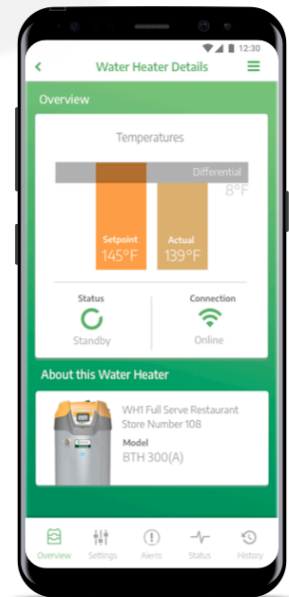- Remote, automated, continuous system integrity monitoring
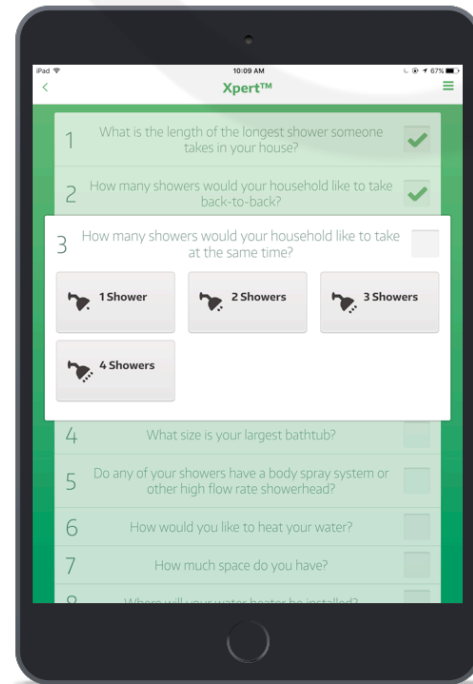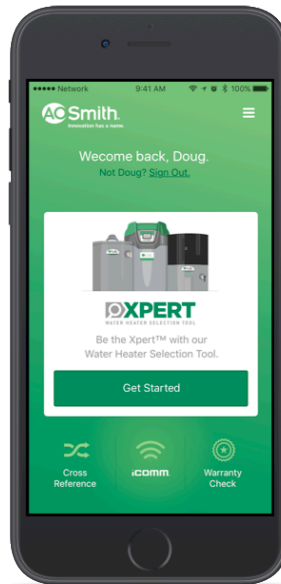
Nautilus Technologies

Experience

Intelligent Hot Water Heater Network

National Hot Water

- integrated monitoring of hot water systems in national network of restaurants

- control systems

- control pressure and temperature

Projects Completed

- Weapons Safety using Biometrics Identification

- Interface for accelerometers and inertial measurement units

- Circuit board design for Bluetooth communication in medical applications incorporating vibrating motors

- Developed mechanics in the robotic "crawler" for assisting infants with cerebral palsy learning to crawl

HVAC SYSTEM MONITORS; VIRTUAL FLOWMETERS; NEW PRESSURE SENSOR MECHANISMS; DOWNHOLE TELEMETRY

University of Oklahoma Wind Tunnel Redesign and Aircraft Integrity testing

- Drones (all sizes) with customization and testing
- Small aircraft
- Structural integrity
- Analytics / predictive maintenance
- Precision surveillance
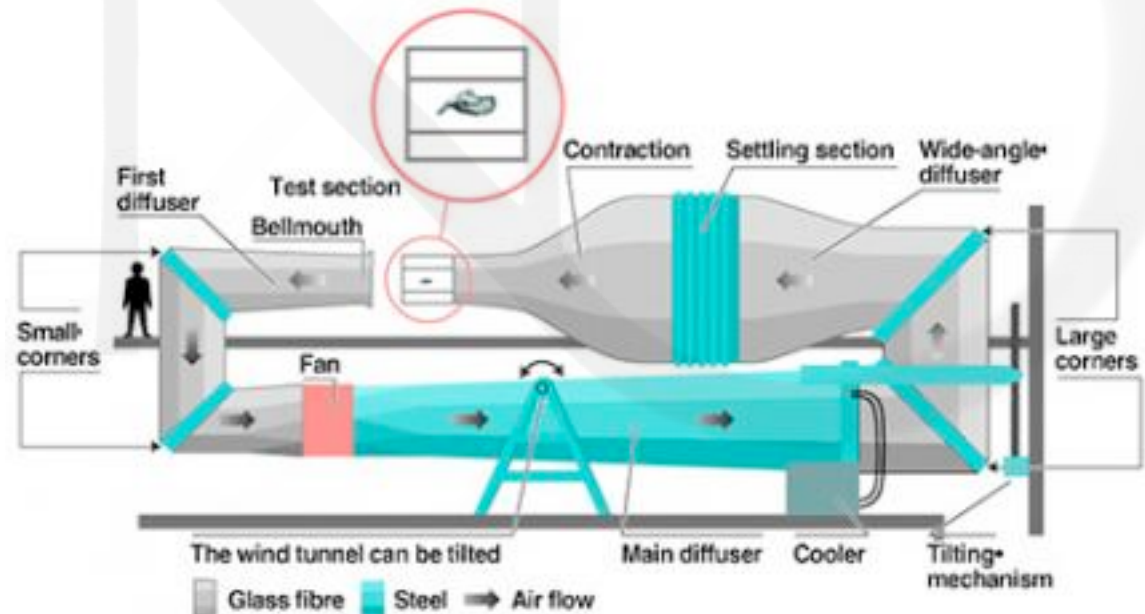
Robotics for Performance Enhancement: Crawler

On the lead engineering team for bio-robotics:

To detect cerebral palsy in infants, researchers at the University of Oklahoma have developed a motorized robot for children to wear, tracking brain activity and muscle coordination using artificial intelligence.
The robot—a cross between an exoskeleton, a skateboard, and a onesie—is designed to prevent muscle atrophy in children who have difficulty crawling.

https://www.pcmag.com/news/346567/with-robotic-exoskeleton-scientists-teach-kids-to-crawl
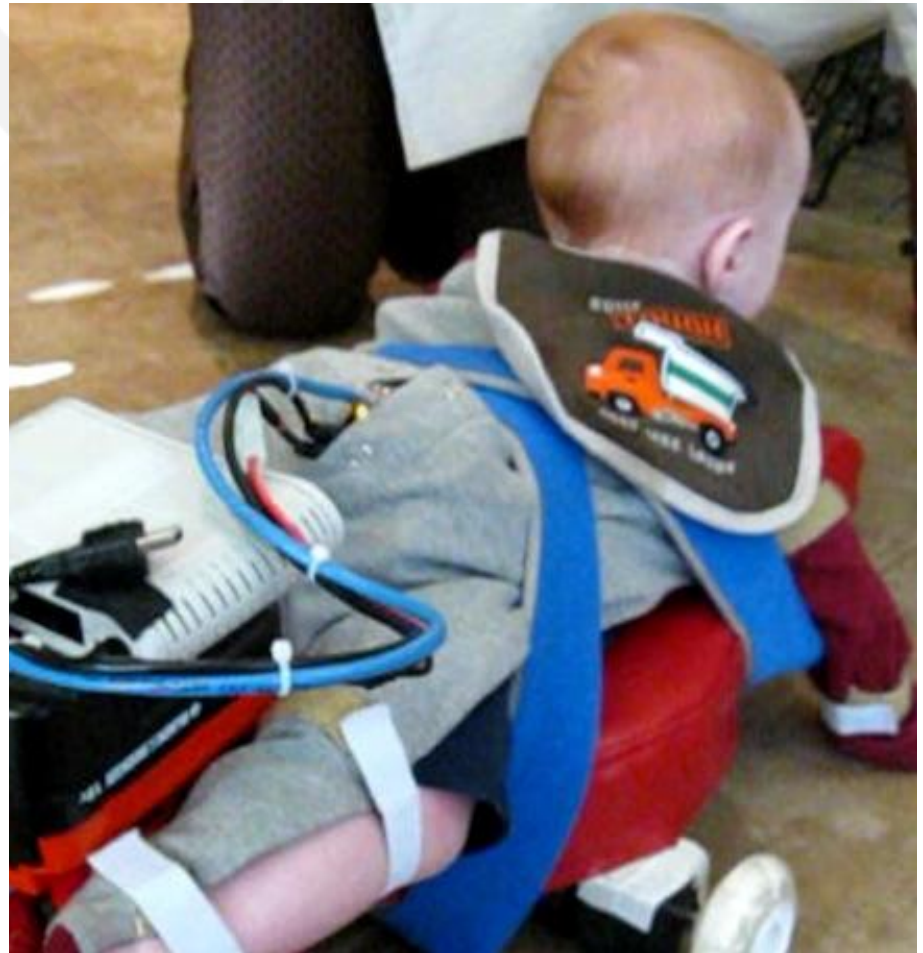
Ongoing Technology Development

What is Nautilus Technologies?
The home of new solutions, technologies, and engineering solutions
- System insight for process optimization
- Robotics
- Intelligent systems
- Control systems
- Cutting-edge measurement and sensing
- Onsight technology consultation: finding appropriate solutions

Industries
- Energy
- Transportation
- Aerospace
- Nautical / ocean-based
- Robotics operations

Michael D. Nash, Ph.D.

Ph.D. in Mechanical Engineering

Concentrations in robotics, automation/intelligent systems and sensor engineering.

Details in LinkedIn:

https://www.linkedin.com/in/mdnash1/