

UltraSep Acoustic Separation Platform

Resonance-Driven, Energy-Optimized Solid-Liquid Separation

Value Proposition

UltraSep is an intelligent ultrasonic separation platform that transforms solid-liquid separation through real-time eigenfrequency resonance locking and ultra-low power energy optimization. By dynamically matching ultrasonic output to system resonance while maximizing particulate removal per unit of applied energy, UltraSep replaces centrifugation and fouling-prone filtration with precision-controlled acoustic forces that significantly reduce power consumption, mechanical complexity, and operating cost while improving recovery performance. This integrated platform unites patented resonance-based acoustic control and energy-per-removal optimization with chemistry-enhanced separation and proprietary system software into a scalable, high-impact commercial technology.

Technology Readiness Level

Core components include issued U.S. patents, operational software, and prior CRADA-backed development with industry and national laboratory partners.

Maturity varies by deployment configuration.

Contact: licensing@lanl.gov

Overview

UltraSep continuously tracks system eigenfrequencies and locks ultrasonic output to resonance, ensuring maximum acoustic energy coupling and eliminating wasted off-frequency power. An auto-tuning algorithm adjusts the ultrasound frequency and amplitude to consistently maximize the separation efficiency in dynamic or inhomogeneous flows. Together, resonance locking and energy-per-removal optimization create a closed-loop, adaptive separation system that converts separation from a mechanically intensive process into a precision-engineered, low-energy acoustic platform.

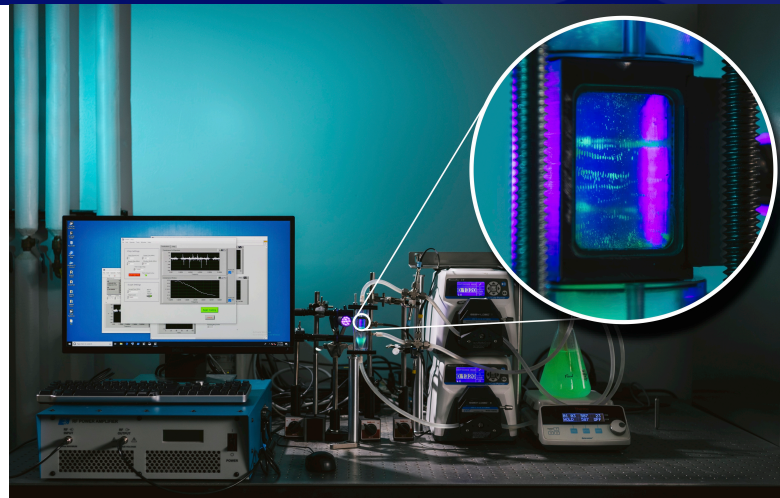


Fig 1. UltraSep system showing integrated hardware and real-time control software during operation. The inset highlights the ultrasonic acoustic field inside the chamber, where sound waves organize and concentrate particles to enable efficient separation.

IP Portfolio

The UltraSep platform is supported by a layered intellectual property framework covering acoustic physics, energy optimization, chemical process enhancement and system control software. This layered IP strategy protects not only individual components, but the integrated system architecture that enables intelligent, energy-optimized separation performance.

Issued U.S. Patents

U.S. Patent 10,428,324

- Acoustic Manipulation of Fluids Based on Eigenfrequency
- Expires March 19, 2037

U.S. Patent 11,395,982

- Ultra-Low Power Acoustic Separation
- Expires March 17, 2039
- Jointly owned with Sonosep Technologies Inc.

U.S. Patent Application

Application No. 18/889332

- Ultrasonic Separation with pH Control
- Filed September 18, 2024

Copyrighted Software

UltraSep Control Software (T4737)

- Integrated acoustic system control architecture (C+ +/LabVIEW platform)

Perfusion Control Software – PCS (C16112)

- Fluidic timing, valve control, and flow-path management system

Advantages

- Resonance-locked acoustic excitation that maximizes acoustic coupling efficiency and eliminates off-frequency energy loss
- Maximum particulate removal per applied energy through optimized ultrasonic field control
- Integrated resonance tracking and energy optimization for adaptive, closed-loop system performance
- Reduced mechanical complexity and fouling compared to centrifugation and filtration systems
- Scalable, modular architecture for flexible deployment
- Integrated intelligent control software enabling real-time frequency and power optimization

Market Applications

- Nuclear materials processing
- Rare earth and critical mineral recovery
- Industrial solid–liquid separation
- Food and beverage processing
- Pharmaceutical processing
- Bioprocessing and algae systems
- Environmental remediation
- High-value particle recovery

Competitive Position

UltraSep is a platform technology, not a single device.

It unifies resonance-locked acoustic control, ultra-low power optimization, chemistry-enhanced separation, and proprietary system software into a defensible system protected by layered IP coverage through 2039 and beyond.

Contact

To learn more or to discuss potential interest in this technology, please contact the Feynman Center for Innovation at licensing@lanl.gov.