System Linearity Test of Ultra-S series

Product	Ultra-S series: Wideband ultrafast ultrasound imaging platform with arbitrary waveform transmission
Document ID	LY202607011
Version	V1.1
Release Date	2026-07-01

浙 江 利 影 医 疗 科 技 有 限 公 司

Zhejiang Liying Medical Technology Co., Ltd.

Protocol

Subaperture AM: Cyclic transmission patterns: [1 0 1 0], [1 1 1 1], [0 1 0 1] (representing Sub-aperture 1, Full aperture, and Sub-aperture 2, respectively)

Reception: All array elements are used for receiving

Transmit Waveform: Half-cycle rectangular pulse

Transmit wavefront: Non-steering plane wave

Sampling rate: 4 × probe center frequency

Test voltages: Minimum voltage amplitudes, $V_p = 2, 5, 10$

Target: Underwater experiment using a silicone tube. The cancellation effect is the primary concern.

Target position: Approximately 5 cm depth

Data content: Raw data (samples × channels × frames), sampling rate, probe parameters (element positions, etc.)

Experimental Setup

A linear probe from Norayso (L8-128) was used with a transmit frequency of 8 MHz. Both systems from LY Cancare (Ultra-S256) and one US company (the state-of-the-art programmable research ultrasound platform in the United States, referred to as the "Latest-generation platform in the US") were tested using the same probe under identical imaging protocols.

The sampling rates were:

- Ultra-S256: $125/4 = 31.25$ MHz
- Latest-generation platform in the US: $8 \times 4 = 32$ MHz

Transmit voltages:

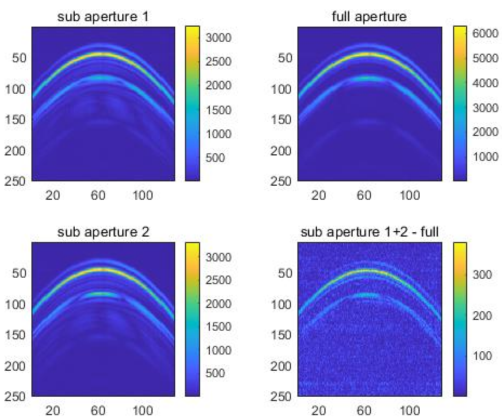
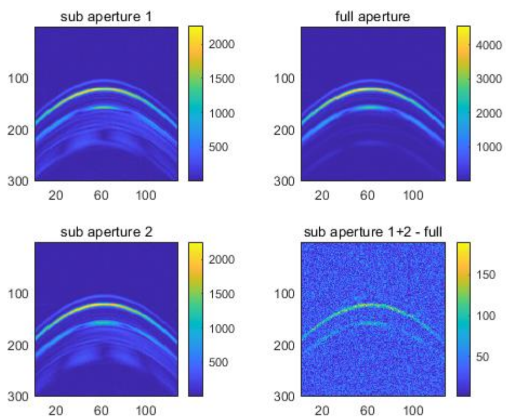
- 2 V, 5 V, 10 V (i.e., $V_{pp} =$ 4V, 10 V, and 20 V)

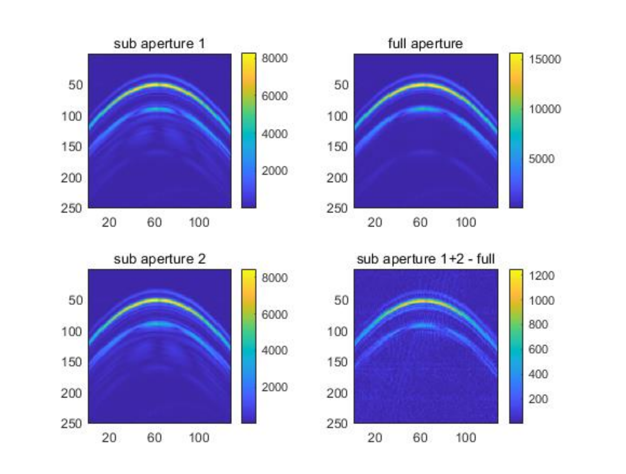
The experimental setup is shown below: the silicone tube (inner diameter: 0.4 mm, outer diameter: 0.9 mm) was immersed in water at 5 cm depth and positioned perpendicular to the imaging plane of the probe.

Channel Data Visualization

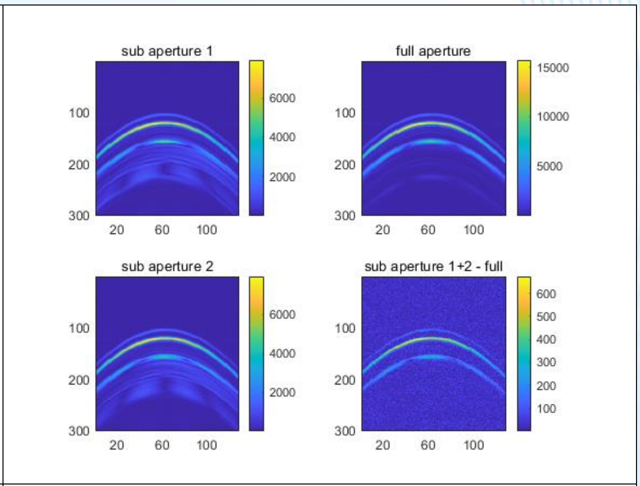
Figure 1 represent the raw channel signals acquired from the Latest-generation platform in the US and Ultra-S256 systems across different voltage levels:

- The two subplots on the left show the sub-aperture signals (**Sub-aperture 1** and **Sub-aperture 2**).
- The top-right subplot shows the **Full-aperture** signal.
- The bottom-right subplot represents the **Residual Signal** after Amplitude Modulation (AM) cancellation (calculated as: Sub-aperture 1 + Sub-aperture 2 − Full).
- *Note:* The dynamic ranges and colorbar limits differ between subplots to maximize visual clarity for each individual signal components.

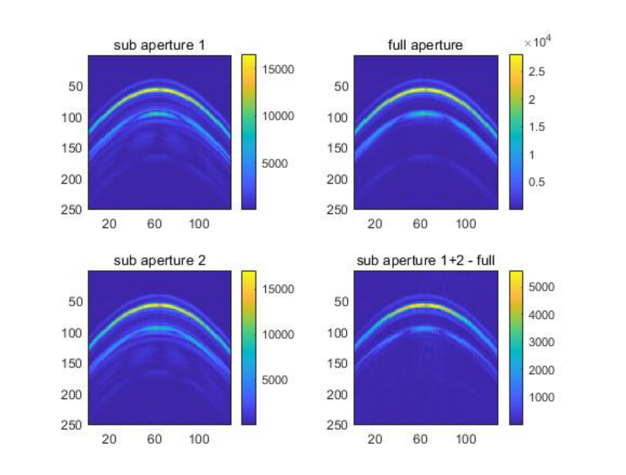
	
Latest-generation platform in the US 2V	Ultra-S256 2V



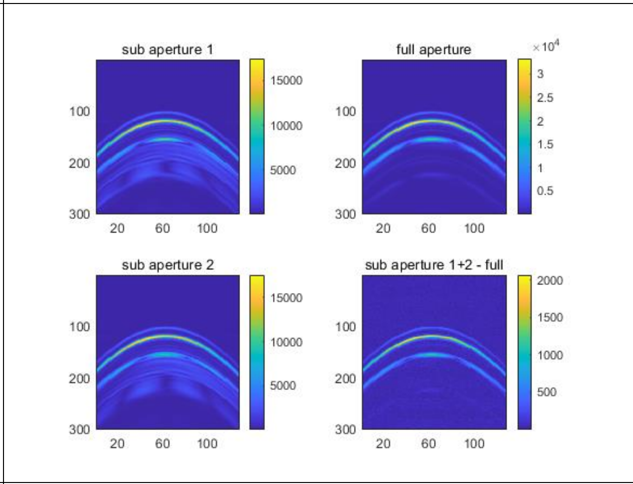
Latest-generation platform in the US 5V



Ultra-S256 5V



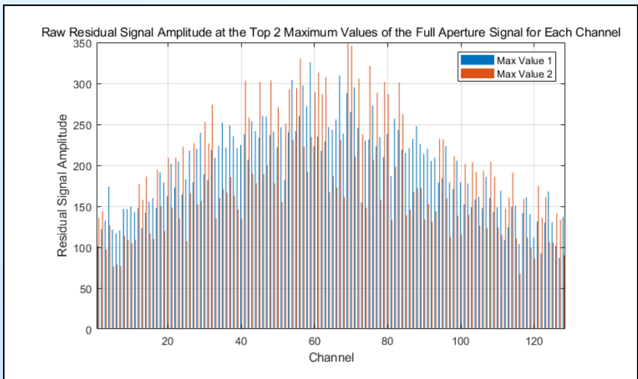
Latest-generation platform in the US 10V



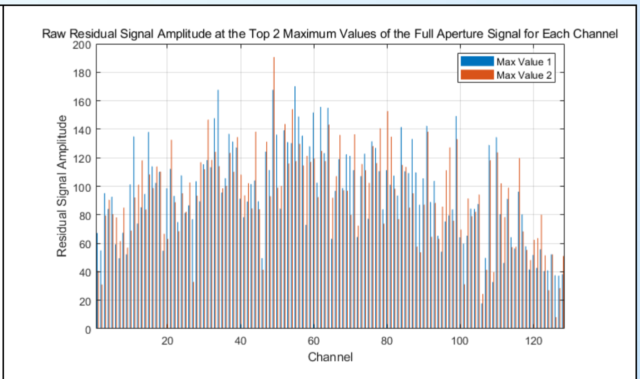
Ultra-S256 10V

Figure 1. Raw channel data acquired from the Latest-generation platform in the US and Ultra-S256 systems across different voltage levels

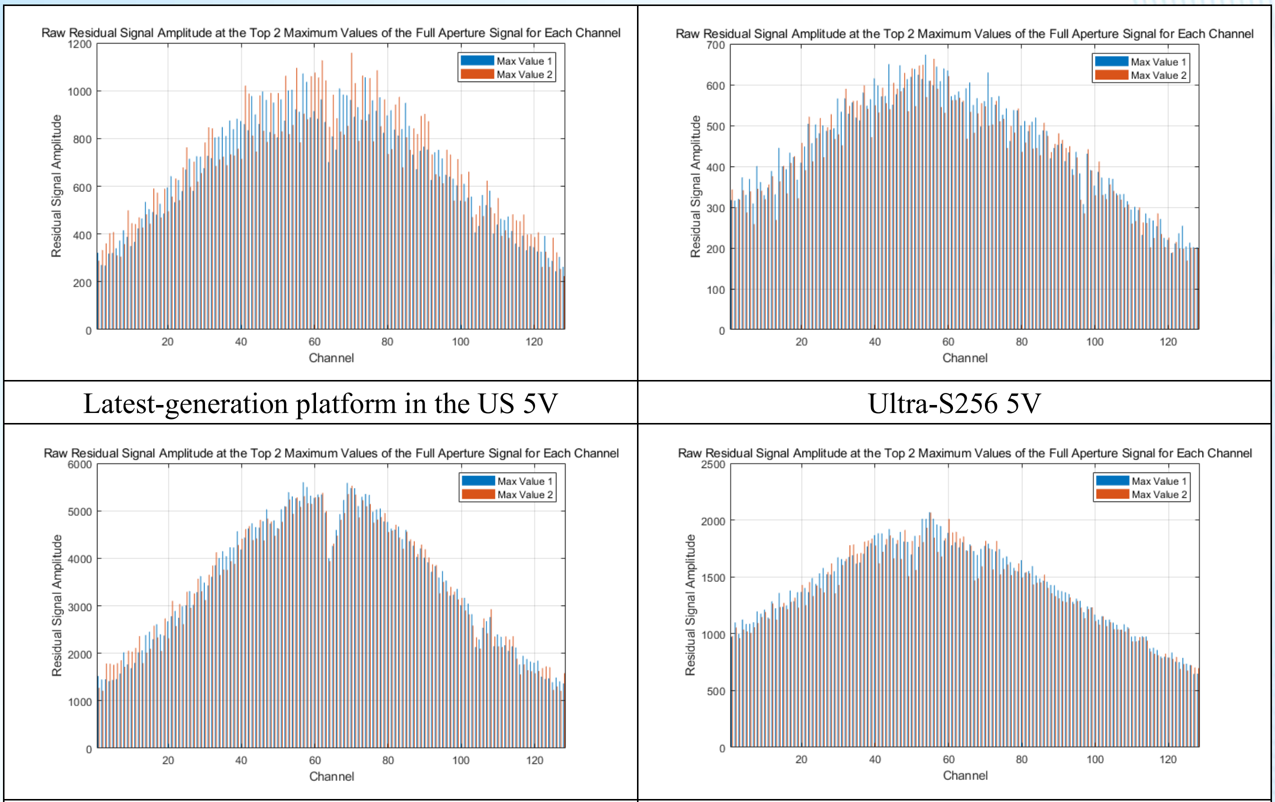
Under identical experimental conditions, the raw signal amplitudes captured by the Latest-generation platform in the US and Ultra-S256 systems are comparable. For both platforms, as the transmit voltage increases, the raw signal amplitude increases. Consequently, the amplitude of the residual (non-cancelled) signal also increases with higher excitation voltages. The peak amplitude of the residual signal for each channel, as shown in Figure 2.



Latest-generation platform in the US 2V



Ultra-S256 2V



Latest-generation platform in the US 5V	Ultra-S256 5V
Latest-generation platform in the US 10V	Ultra-S256 10V

Figure 2. Residual signal amplitude of the Latest-generation platform in the US and Ultra-S256 systems across different voltage levels

Calculation Method

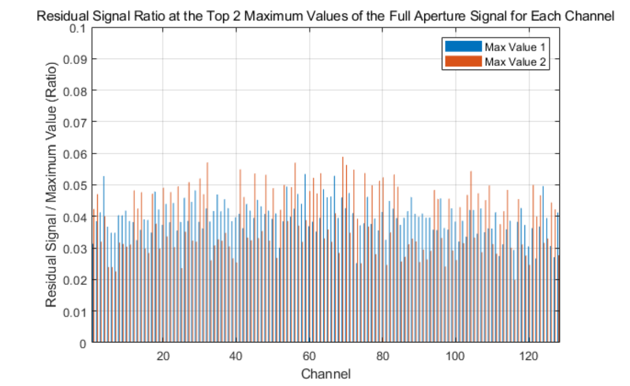
1. **Signal Definitions:** Three consecutive signal frames ($rf1$, $rf2$, and $rf3$) were selected.
    - $rf1$ and $rf3$ correspond to the sub-aperture signals.
    - $rf2$ corresponds to the full-aperture signal.
2. **AM Residual Calculation:** The AM-combined residual signal (rf_{AM}) was calculated as:

$$rf_{AM} = rf1 + rf3 - rf2$$

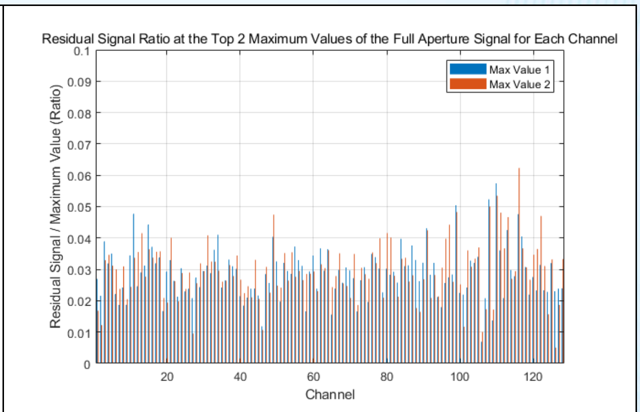
3. **Peak-based Ratio Extraction:** Within the depth region containing the target (silicone tube), the top two maximum values of $|\, rf2 \,|$ were identified for each of the 128 channels. The residual signal amplitude (rf_{AM}) at those corresponding sample indices was then divided by the peak full-aperture amplitude ($rf2$). The **Linear Signal Cancellation ratio** (LSC) at these peak indices is defined as:

$$LSC = \left.\frac{|\,rf_{AM}\,|}{|\,rf2\,|}\right|_{\text{at max}(|rf2|)}$$

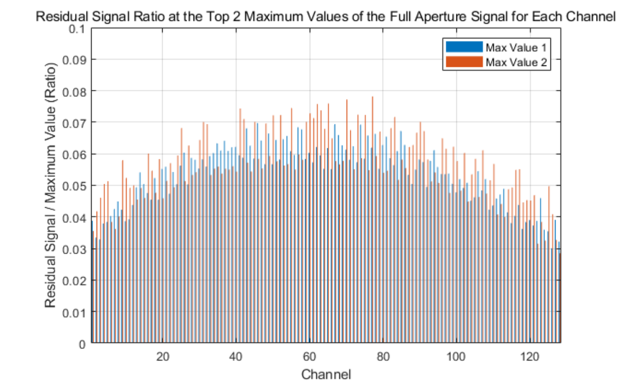
Results Comparison



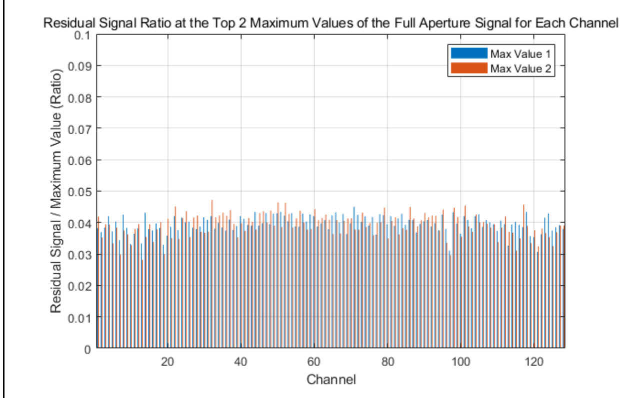
Latest-generation platform in the US 2V



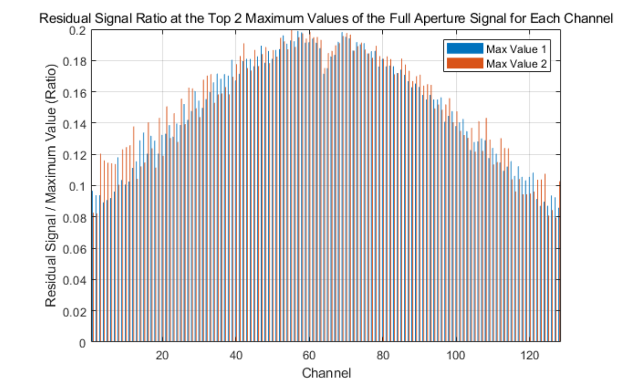
Ultra-S256 2V



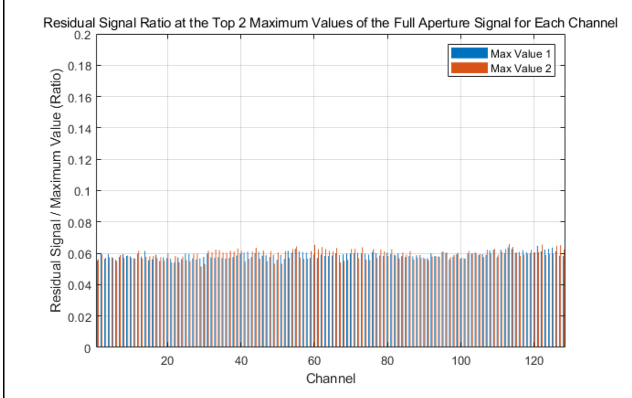
Latest-generation platform in the US 5V



Ultra-S256 5V



Latest-generation platform in the US 10V



Ultra-S256 10V

Figure 3. LSC of each channel of signal acquired from the Latest-generation platform in the US and Ultra-S256 systems across different voltage levels

As shown in the bar chart comparisons (Figure 3), the residual signal ratio (LSC) for both Latest-generation platform in the US and Ultra-S256 increases as the transmit voltage increases, which is a typical indicator of system non-linearities at higher pressures.

However, under all tested voltage conditions, the **Ultra-S256 system consistently achieves a lower residual signal ratio than the Latest-generation platform in the US system**, indicating superior linearity and better signal cancellation performance.

To quantify this comparison, the mean residual signal ratio (LSC) across all 128 channels was calculated. The mean values are summarized in the table below:

Transmit Voltage (V_p)	Latest-generation platform in the US (Mean LSC)	Ultra-S256 (Mean LSC)
2V	0.0396	0.0288
5V	0.0534	0.0396
10V	0.1494	0.0590

DISCLAIMER & NOTICE

1. Experimental Conditions: All performance metrics and comparative data presented in this report were obtained under specific laboratory conditions and using designated parameters (e.g., specific pulse types, target depth, and sampling rates) as detailed in the Protocol section. Actual performance in real-world or clinical applications may vary based on environmental factors, user configuration, operating procedures, and accessory hardware.
2. No Guarantee of Performance: This document is provided for technical reference and evaluation purposes only. It does not constitute a warranty, express or implied, regarding the commercial suitability or performance of any system under non-tested conditions.
3. Data Verification: The comparative data reflects measurements taken at the time of testing on specific units. LY Cancare reserves the right to update product specifications and test methodologies without prior notice as technology evolves.

Copyright and Legal Notice

Copyright

Restrictions on Use and License

This manual is intended for use solely in conjunction with the product series developed by the Company. Users shall not reverse engineer, decompile, disassemble, or attempt to extract the underlying source code or undisclosed hardware control architecture of the product hardware or software systems.

Programming Disclaimer and Limitation of Liability

The Company shall not assume any legal or compensatory liability for equipment damage, data loss, performance degradation, or any indirect losses resulting from user-written code, custom script execution, parameter modifications beyond the recommended range, or improper operation.

**Note: The Company reserves the right to update this manual at any time in response to technological advancements without prior notice.*

After-Sales Service

- **Company Name:** Zhejiang Liying Medical Technology Co., Ltd.
- **Address:** Room 511, Building 4, Boduo Sengo Jinheng Road, Liangzhu Subdistrict, Yuhang District, Hangzhou, Zhejiang Province, China
- **Tel:** +86 18683097166, +86 18958082922
- **Postal Code:** 310012
- **Email:** cancare3d@163.com

We provide online technical support within 24 hours. Please feel free to contact us with any questions.