Ai Linear's Vision of the future of Distributed Intelligence

AI will be Everywhere and Always-On (AI on Sensors: AI Dust). "AI Everywhere" neither needs to rely on the INTERNET nor the CLOUD for intelligence.

Health, Safety, and Efficiency

Distributed Intelligence (i.e., ultra-edge machine learning, AI near/in sensors and devices, smart sensors) will be everywhere, quietly helping to keep people, the environment, industries, and things safe, healthy, and efficient with unimaginable new capabilities. The privacy and safety benefits of AI near sensors, with pre-defined and limited intelligence, will accelerate its adoption in response to growing concerns and mistrust of overreaching, hard-to-regulate, and increasingly pervasive CLOUD-based intelligence.

Ultra-Portability

AI in sensors and devices will be fueled by:

1. Applications requiring continuous "always-on" monitoring, demanding ultra-low-power, battery-less operation due to limited access to power sources.
2. Applications that are hard to reach or maintain and have size constraints.
3. The need to detect "important" outputs from sensors and avoid sending "unimportant" data to the CLOUD, which wastes power and incurs costs due to reliance on communication (I/O) with the CLOUD for intelligence.
4. Applications that cannot tolerate the latency associated with CLOUD communication.
5. The availability of custom ultra-low-power, limited-data I/O that may bypass Wi-Fi/Bluetooth/5G, favoring simpler solutions like those used in car keys, baby monitors, or garage openers.

Less Wasteful Data on Cloud, New Data/Analytics Software

Distributed Intelligence will pre-filter wasteful data near sensors before sending it to the CLOUD. This will give rise to new software and data analytics derived from AI in sensors and devices, further driving the fusion of sensors with machine learning capabilities.

Machine Learning + Sensors = AI in Sensors and Devices

We are at the tip of the iceberg for a wave of new data generated by smart sensors, spanning images, sounds, vibrations, leaks, location, smells, tastes, pressure, toxicity, temperature, humidity, gases, acceleration, shocks, sweat, coughing, falling, and more.

Shift from Cloud to Fog

There will be a significant shift of intelligence from the CLOUD to the FOG due to:

1. **Privacy & Safety:** Some customers or applications cannot trust the CLOUD and prefer to keep data "on-premises," effectively creating a "private-cloud."
2. **Latency:** The CLOUD generally lacks runtime guarantees. By using a FOG or private-cloud, customers can retain control and ensure availability as required.
3. **Application-Specific ASIC Accelerators:** Tailored to specific data loads, these FOG-based platforms enable less power-hungry communication with application-specific AI near sensors and devices.

Hybrid Computing Will Gain Market Acceptance

Analog and mixed-mode accelerator ICs (utilizing novel analog architectures and algorithms) will be paired with digital processor ICs (utilizing application-specific digital architectures and algorithms) for segmented signal processing. Digital processors will handle precise computations after analog accelerators perform approximate computations on incoming data, significantly reducing overall system cost and power consumption.

Growth in Application-Specific AI Accelerators with Thin Software

The growth of application-specific AI accelerators with thin software in the FOG will surpass that of general-purpose and fully programmable computation engines. Start-ups chasing AI software based on general-purpose platforms face challenges:

1. Software innovations are less likely to receive patent protection due to USPTO's reluctance toward software-based patents.
2. Large conglomerates dominate the FOG-based AI software and general-purpose computation spaces, leaving fewer opportunities for start-ups.
3. These conglomerates will push for low-power, low-cost application-specific AI accelerators with thin software, rather than general-purpose engines.

Analog is a Natural Fit for AI in/Near Sensors

The real world is analog, not digital. Analog ICs interface more naturally with real-world signals, which are inherently approximate. Analog solutions can perform approximate computations with lower power and cost compared to digital solutions. With the end of Moore's Law, OEMs can no longer rely on continually cheaper and denser digital ICs. The dominance of bleeding-edge IC manufacturing by a few heavyweights adds risk, as these suppliers may lack incentives to lower costs significantly.

Innovations in Mixed-Signal R&D Tools and Fabrication

The end of Moore's Law does not signal the end of innovation. Advances in silicon fabrication will focus on making transistors more *accurate*, not just denser. These improvements will empower Mixed-Signal IC development to rival pure digital IC workflows. Innovations in CAD/automation tools will reduce time-to-market and NRE for Mixed-Signal ICs, driving adoption of Distributed Intelligence based on analog and mixed-signal technologies.

Rise of Analog Software with Hybrid Computing and Analog Computers

As Moore's Law fades, silicon manufacturing innovation shifts from increasing *density* to improving *accuracy*. This will pave the way for rugged analog accelerators and hybrid computing (analog assisting digital). New categories of thin, efficient software tailored to analog and mixed-signal computation engines will emerge, supporting standalone analog computers and furthering the adoption of hybrid systems.