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Asia Emerging Robotics

China Next Winners: What if harmonic reducers matter less than expected? We prefer Shuanghuan



Dien Wang, Ph.D.
+852 2123 2622
dien.wang@bernsteinsg.com

This report is part of a series on China Next Winners in which we identify the next generation of industries and corporate winners in China.

In this report, we challenge the notion that harmonic reducers are indispensable to humanoid robots, and prefer **Shuanghuan** because of its comprehensive expertise and product portfolio in gears and reducers (Exhibit 15). Although we highlighted this strength in our initiation (here), we deliberately did not explore the thesis in depth, as the conclusion was highly counterintuitive at the time. Today, however, we believe investors should pay closer attention to the reducer roadmap, as mounting evidence suggests that harmonic reducers may not be the inevitable solution many investors believe (Exhibit 1).

The game is changing as robotic intelligence increasingly compensates for mechanical precision. Harmonic reducers have been the preferred solution thanks to their superior precision, zero backlash, compact size, etc. (Exhibit 11). Yet growing evidence suggests that many daily tasks may not require ultra-high mechanical precision (Exhibit 7), as vision-based closed-loop control can continuously correct robotic arm positioning errors in real time. This helps explain why low-cost robotic arms built around planetary reducers (Exhibit 2 to Exhibit 6) are increasingly capable of performing practical tasks. For example, X Square sorted parcels with high speed and accuracy (video). Robotic "brain" leaders like Physical Intelligence and Google are also building on similarly simple hardware platforms (Exhibit 8 and Exhibit 9). If low-cost arms can adequately handle daily tasks, the necessity of harmonic reducers could be materially overstated. The future of robotics may rely less on mechanical precision (e.g. harmonic reducers), while placing greater demands on other, often-overlooked hardware attributes (e.g. noise).

Even without advanced intelligence, harmonic reducers may not be the optimal solution for the upper body of legged robots. Like humans, bipedal robots constantly make balance corrections (Exhibit 12 and Exhibit 13), and the resulting body sway can overshadow the precision advantage of harmonic-reducer-based joints. In addition, falls can generate significant impact loads, raising the risks of damage to harmonic reducers.

How should we think about harmonic reducers? We believe harmonic reducers are important, but not indispensable. Going forward, humanoid OEMs are likely to prioritize the best system-level trade-off rather than maximum mechanical precision. Harmonic reducers will continue to compete with alternative reducer solutions across cost, durability, torque, weight, size, etc. While their necessity may be lower than commonly assumed, declining unit costs (Exhibit 14) should keep them an important option for robotics.

Shuanghuan's full potential may finally be unleashed. We view the termination of the planned spin-off listing of its robotic reducer subsidiary on September 3 as a key inflection point. The subsidiary listing process had constrained collaboration and resource sharing between the parent and subsidiary due to concerns over horizontal competition and related-party transactions. With this overhang now removed, we believe Shuanghuan is better positioned to capture the growing robotics opportunity (Exhibit 15 to Exhibit 18).

See the Disclosure Appendix of this report for required disclosures, analyst certifications and other important information. Alternatively, visit our Global Research Disclosure Website.

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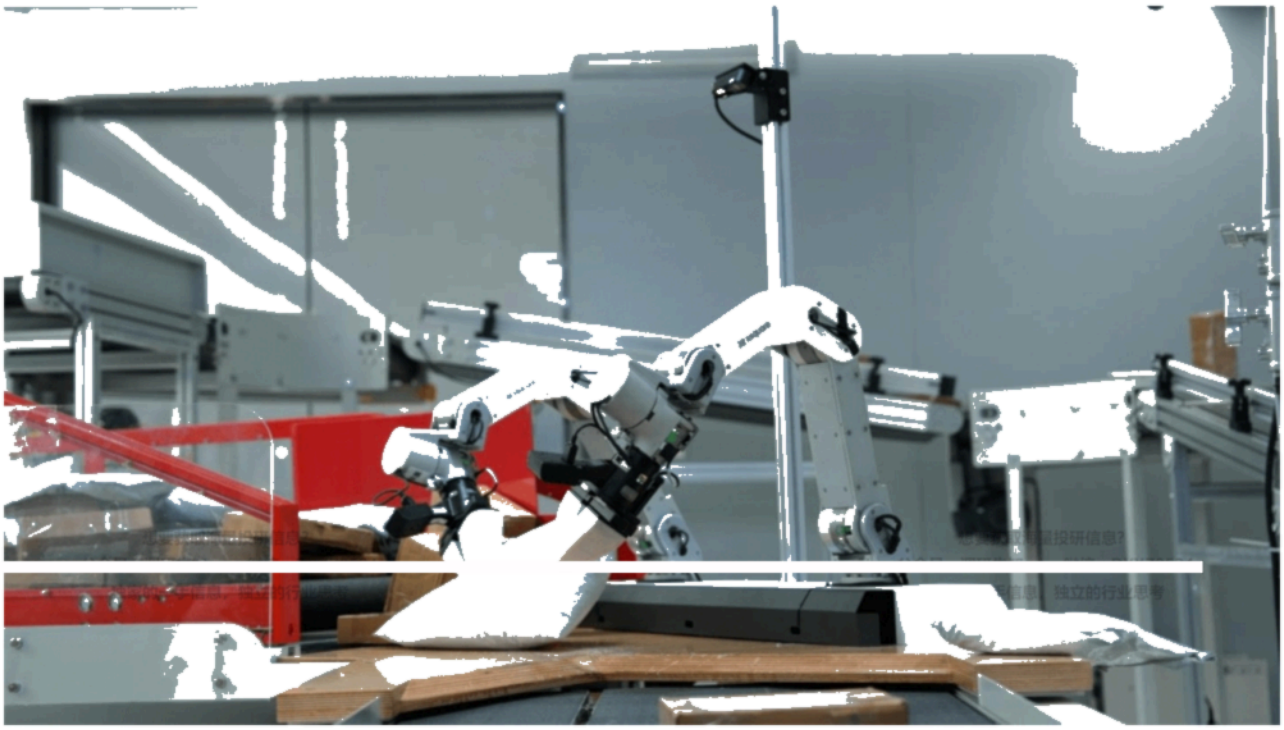
DETAILS

EXHIBIT 1: **Shuanghuan trades at a significant discount to Leader Drive on 1-year forward PE**



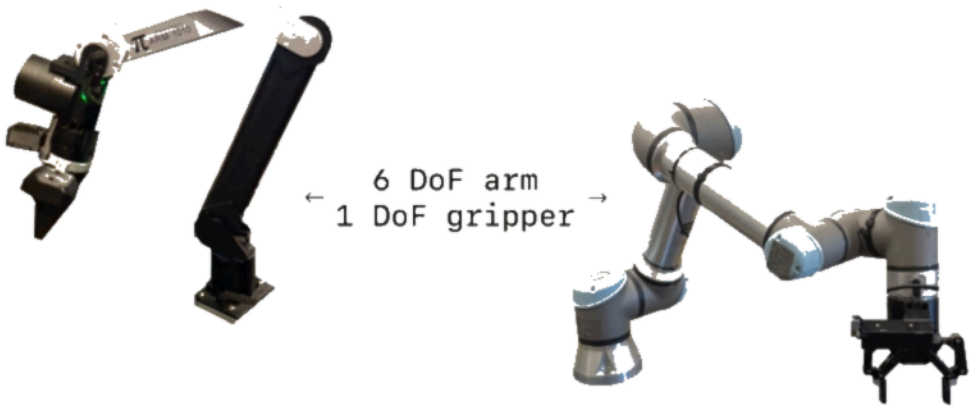
Source: Bloomberg, Bernstein analysis

EXHIBIT 2: **X Square Robot's 6-axis robot arms sorted 1,816 parcels per hour with over 98% accuracy**



Source: X Square Robot, Bernstein analysis

EXHIBIT 3: **Form-factor comparison: Low-cost robotic arm vs. Collaborative robot**



Source: Physical Intelligence, Bernstein analysis

EXHIBIT 4: **Low-cost robotic arms**

Trossen Robotics



I2RT Robotics



Galaxea

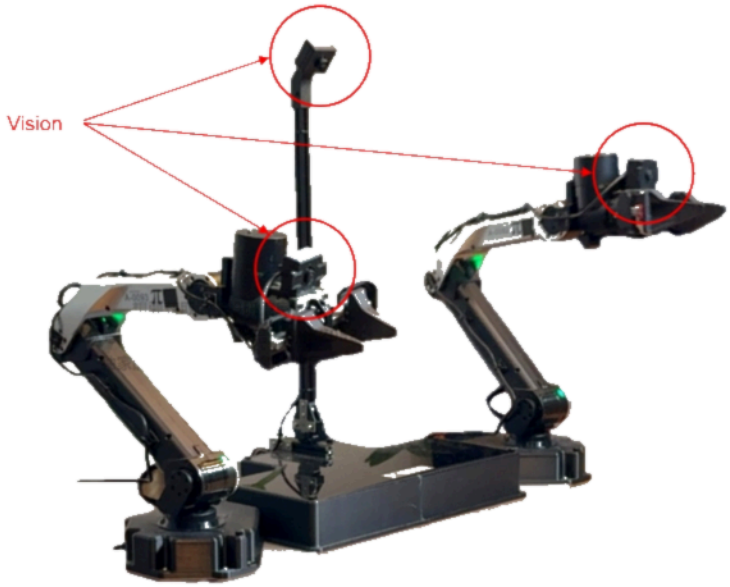


AgileX



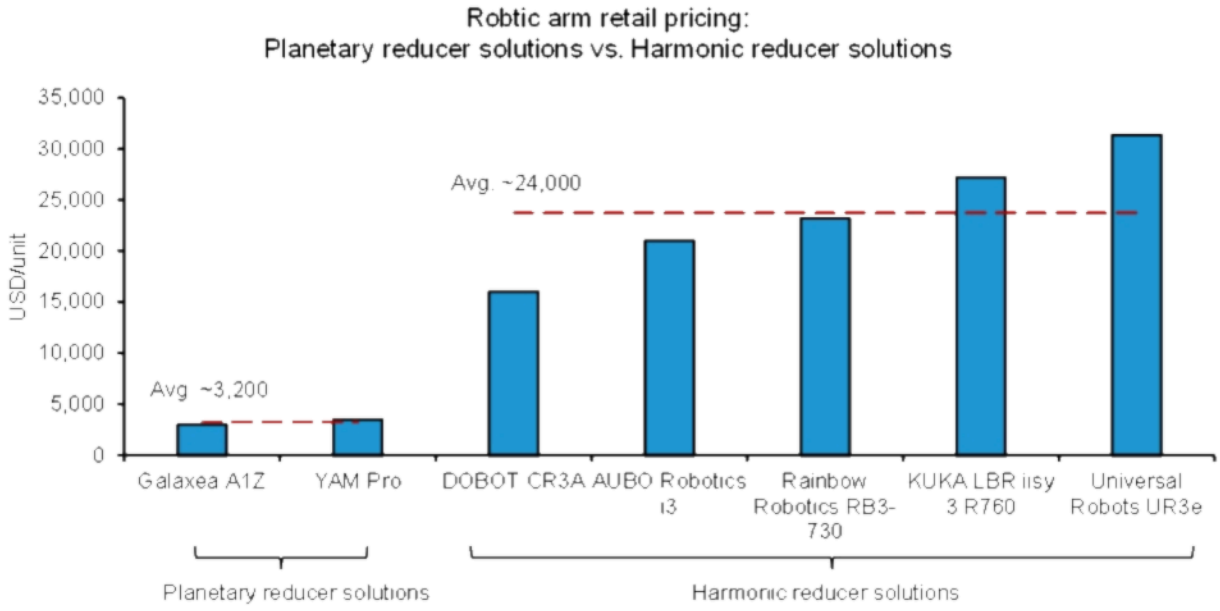
Source: Company websites, Bernstein analysis

EXHIBIT 5: **Low-cost arms with vision system meet the needs for many applications**



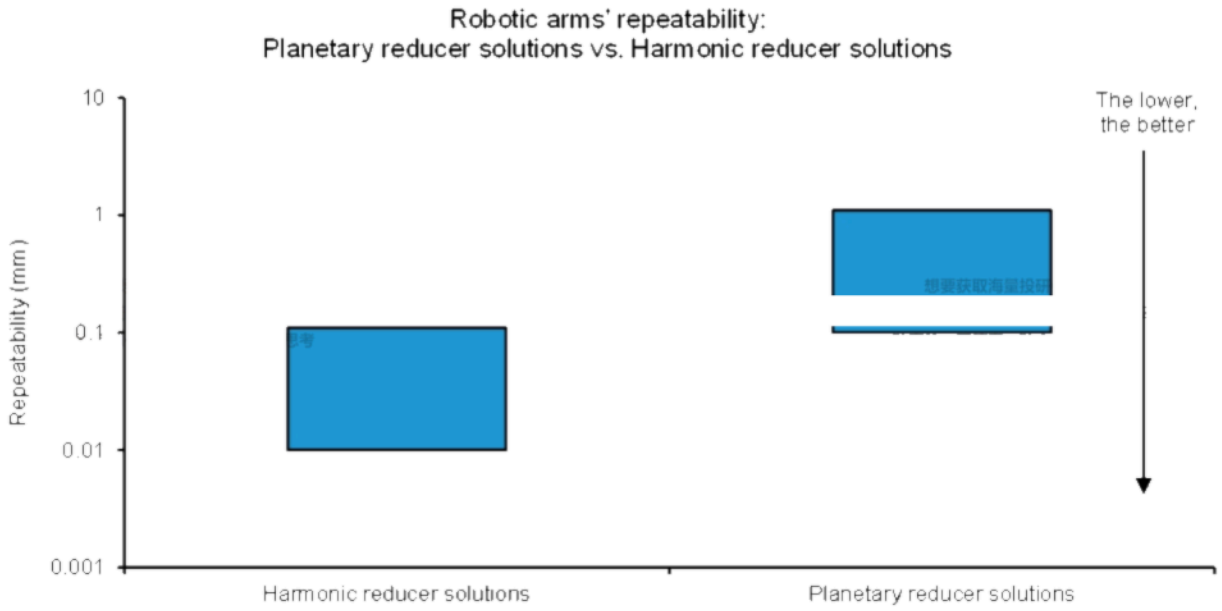
Source: Physical Intelligence, Bernstein analysis

EXHIBIT 6: **Price advantage of planetary-reducer-based robotic arms**



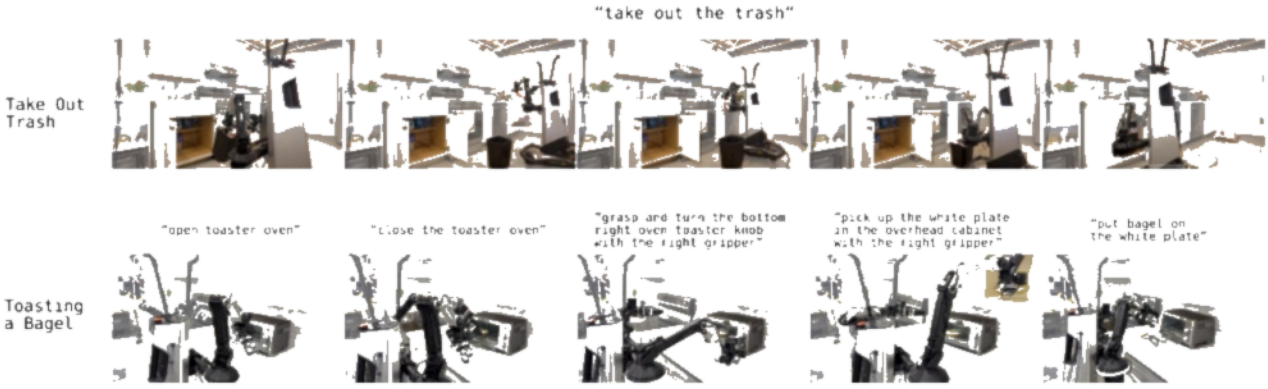
Source: Company websites, Unchained Robotics, Bernstein analysis

EXHIBIT 7: **Precision trade-off of planetary reducer-based robotic arms**



Source: Company websites, product datasheets, Bernstein analysis

EXHIBIT 8: **Physical Intelligence develops its robotic "brain" based on the low-cost arms**



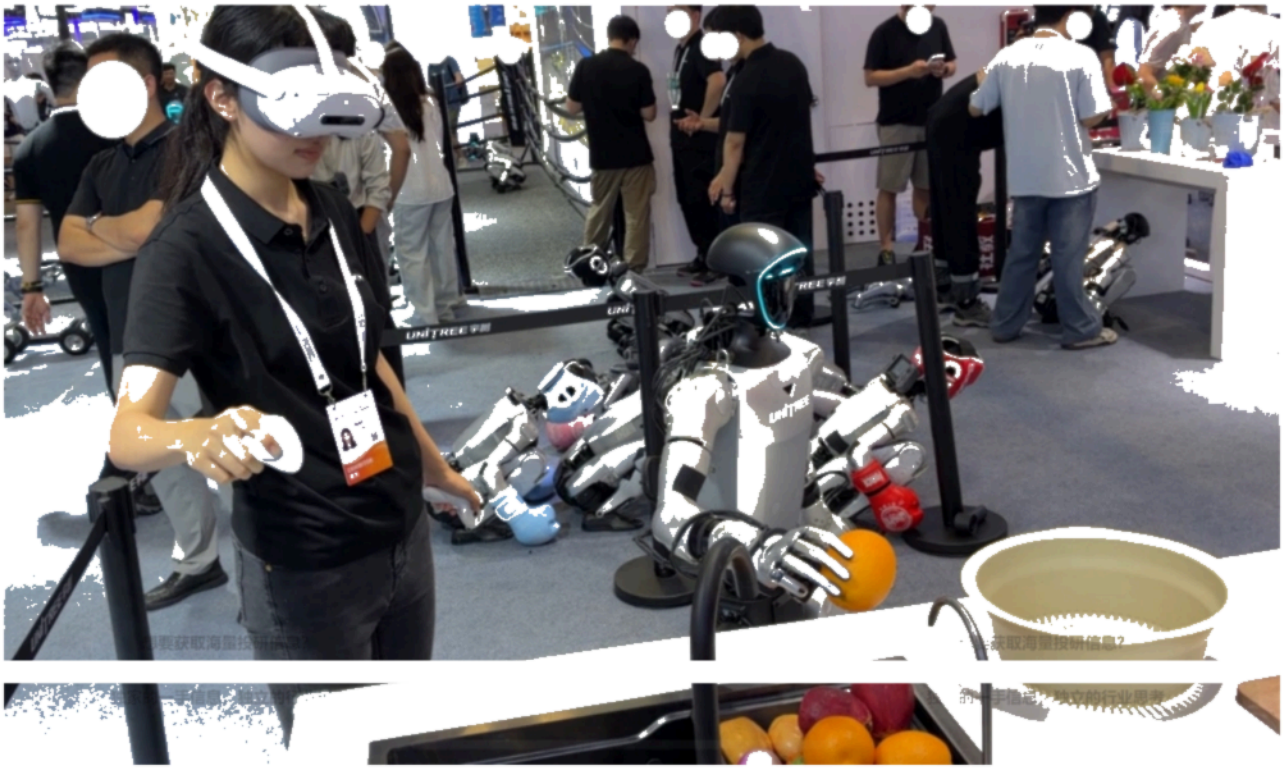
Source: Physical Intelligence, Bernstein analysis

EXHIBIT 9: **Google DeepMind also demonstrated the viability of low-cost robotic arms**



Source: "ALOHA Unleashed: A Simple Recipe for Robot Dexterity", Bernstein analysis

EXHIBIT 10: **Robots without harmonic reducers demonstrated the ability to perform everyday tasks**



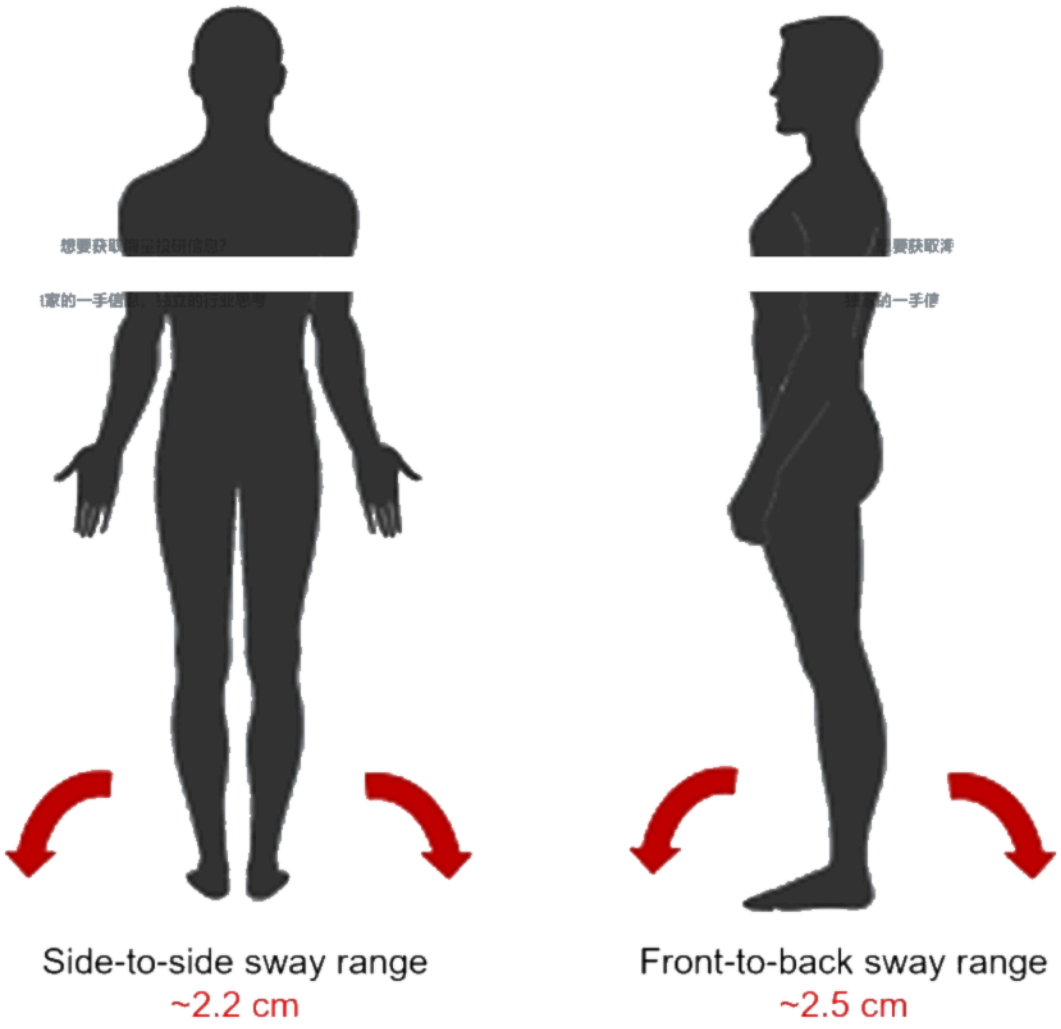
Source: WAIC, Unitree, Bernstein analysis

EXHIBIT 11: **Reducer spec comparison among harmonic reducers, RV reducers and planetary reducers**

Reducer Specs	Harmonic reducer	RV reducer	Planetary reducer
Illustration			
Precision (arc min)	≤ 1	≤ 1	≤ 3
Backlash (arc min)	< 0.5	< 1	5-10
Torsional stiffness (N·m/arc min)	1~54	20~1,200	10~370
Reduction Ratio Range	30~160	30~250	3~512
Operating Efficiency	> 70%	> 80%	> 95%

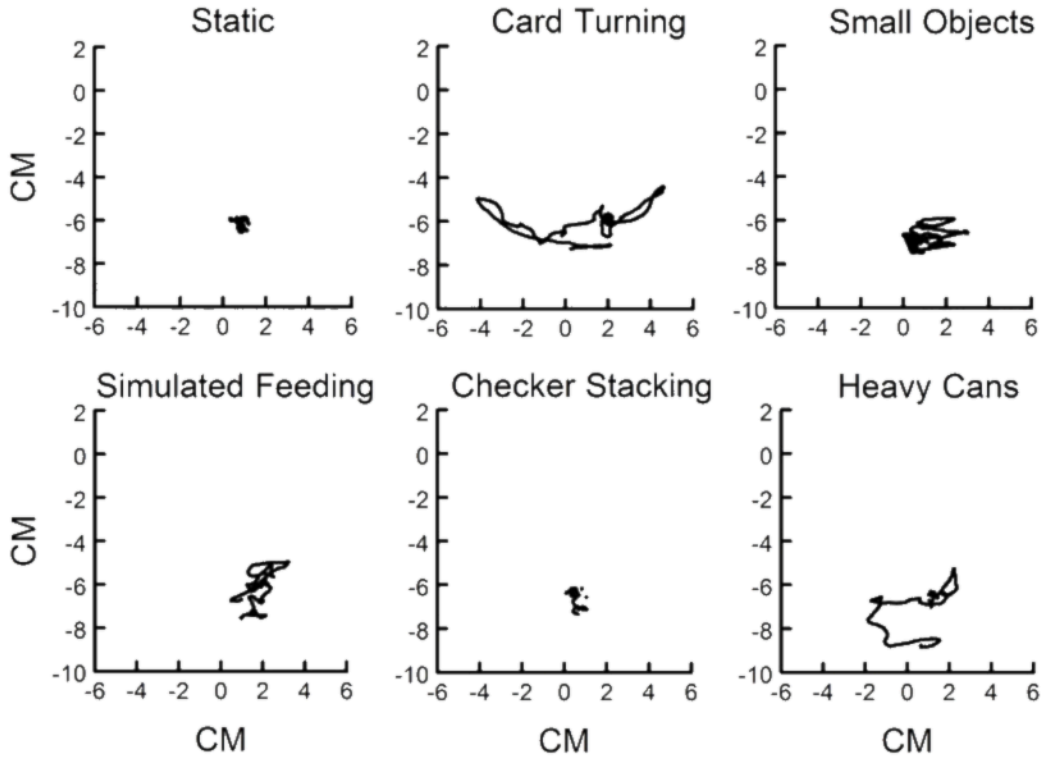
Source: Laifual Drive, Kofon, Bernstein analysis

EXHIBIT 12: **Postural sway occurs at the centimeter scale, which is a substantial displacement to end-effectors (e.g. hands)**



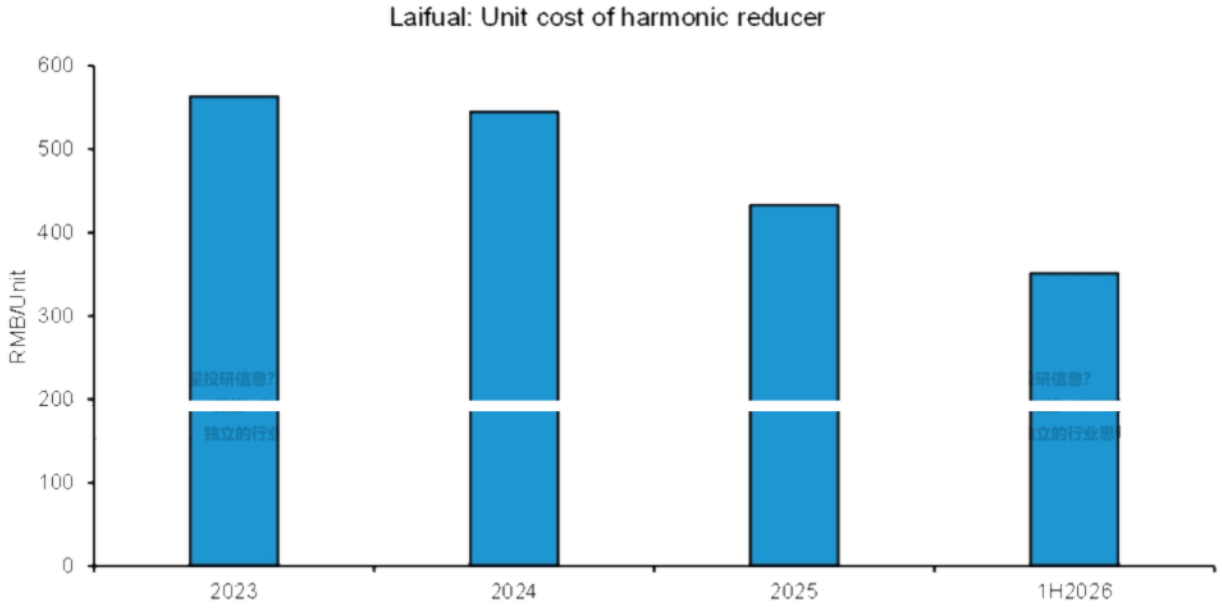
Source: Deborah Apthop, "Estimating whole-body centre of mass sway during quiet standing with inertial measurement units", Bernstein analysis

EXHIBIT 13: **The human body's center of pressure can shift by several centimeters during static stance and while performing various tasks**



Note: CM = centimeters;
Source: "Effect of Standing on a Standardized Measure of Upper Extremity Function", Bernstein analysis

EXHIBIT 14: **Declining unit cost of harmonic reducers**



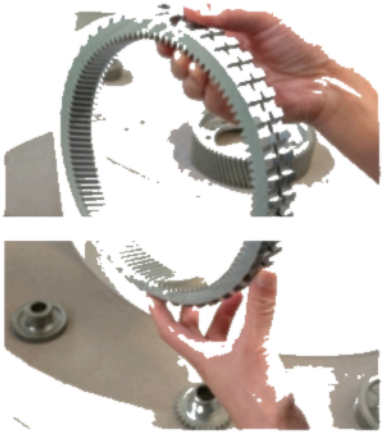
Source: Laifual, Bernstein analysis

EXHIBIT 15: **Shuanghuan: The gear expert with comprehensive product portfolio**

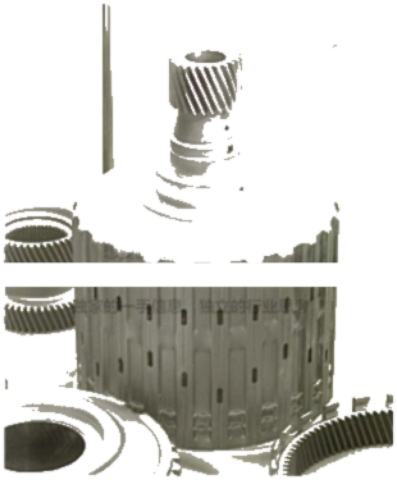
Gears in automotive transmissions (incl. NEV reducer, MT, AMT, DCT, CVT, AT, etc.)



RV reducer

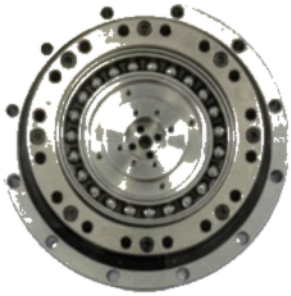


Strain wave reducer



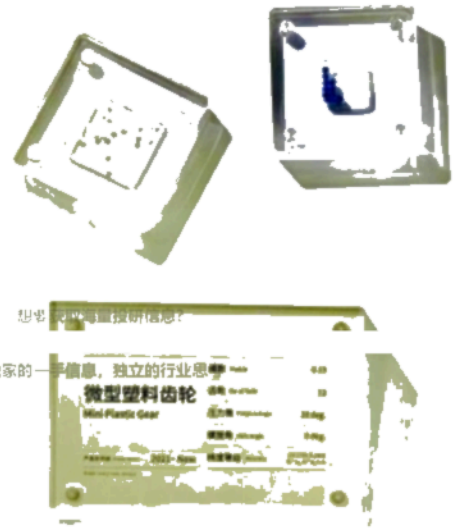
High-precision planetary reducer







Mini plastic gears



Non-metallic gears



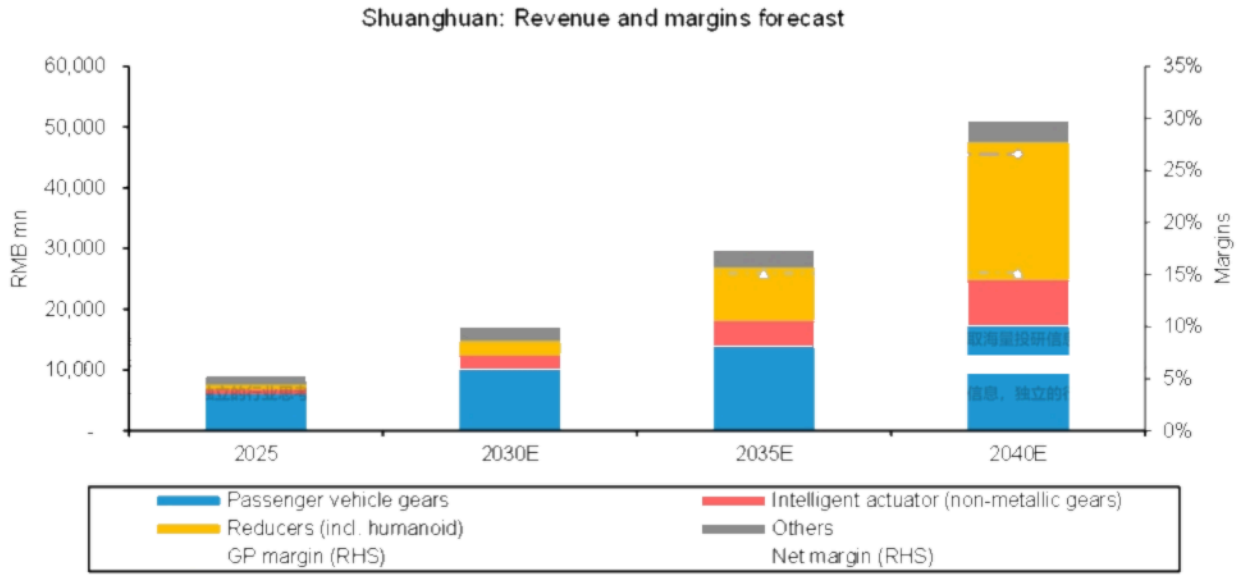
Source: Shuanghuan, Bernstein analysis

EXHIBIT 16: **Shuanghuan supplies reducers for Honor's robots**



Source: CCTV, Etown-halfmarathon, Bernstein analysis

EXHIBIT 17: **Shuanghuan: Forecast on revenue contribution and margins**



Source: Shuanghuan, Bernstein analysis and estimates

EXHIBIT 18: **Shuanghuan: 1-yr forward PE**



Source: Company reports, Bernstein analysis

INVESTMENT IMPLICATIONS

We rate Shuanghuan Outperform and Leader Drive Underperform.

BERNSTEIN TICKER TABLE

Ticker	Rating	Cur	17 Sep 2026 Closing Price	Price Target	TTM Rel. Perf.	Reported EPS Cur	2025A	2026E	2027E	Reported P/E (x) 2025A	2026E	2027E
002472.CH (Shuanghuan)	O	CNY	36.30	60.00	(46.2)%	CNY	1.50	1.59	1.97	24.2	22.8	18.4
688017.CH (Leader Drive)	U	CNY	290.63	115.00	40.9%	CNY	0.69	0.76	0.83	419.7	379.9	350.7
ASIAX			1,927.94									

O - Outperform, M - Market-Perform, U - Underperform, NR - Not Rated, CS - Coverage Suspended

Source: Bloomberg, Bernstein estimates and analysis.

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