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October 06, 2022



*Energy Management Platform to Accelerate the Global
Transition to Circular Electrification Economy*



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Vibration and Energy





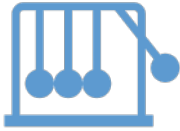
***“If you want to find the secrets of
the universe, think in terms of
energy, frequency and vibration”***

Nikola Tesla

Definition: *A rapid linear and angular motion of a particle or of a solid object about an equilibrium position (two or more things colliding)*

- Vibration is proportional to the amount of mechanical or dynamic disparity within a rotating system and are present in ANY spinning/rotating system or object
- A dynamic imbalance will cause uncontrolled vibration resulting in thermal friction and heat, exponential wear, and ultimately catastrophic damage over time
- Environmental factors in which operated, tiny variabilities in manufacturing, or pushing systems outside of designed parameters can increase vibration significantly
- Higher performance systems are affected the most due to tighter tolerances

Precise vibrational control is critical for
high performance machines and systems to operate safely and achieve mission success



Vibration is Energy

- Unwanted energy created, energy used, energy wasted
- Vibrations negatively affect freedom of movement, requiring more energy to spin or rotate an object or system of objects



Reducing vibration is *Sustainable Energy Management*

- Results in a Circular Electrification of Economy
 - Saving energy by not producing “robbing” vibrational energy (1kw required to produce 1kw)
 - Conservation of momentum



Frequency and amplitude are the measurements of severity

- Frequency is number of times of collision over time (ms to minutes)
- Amplitude is Inches Per Second (IPS) of movement



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Destructive Vibration



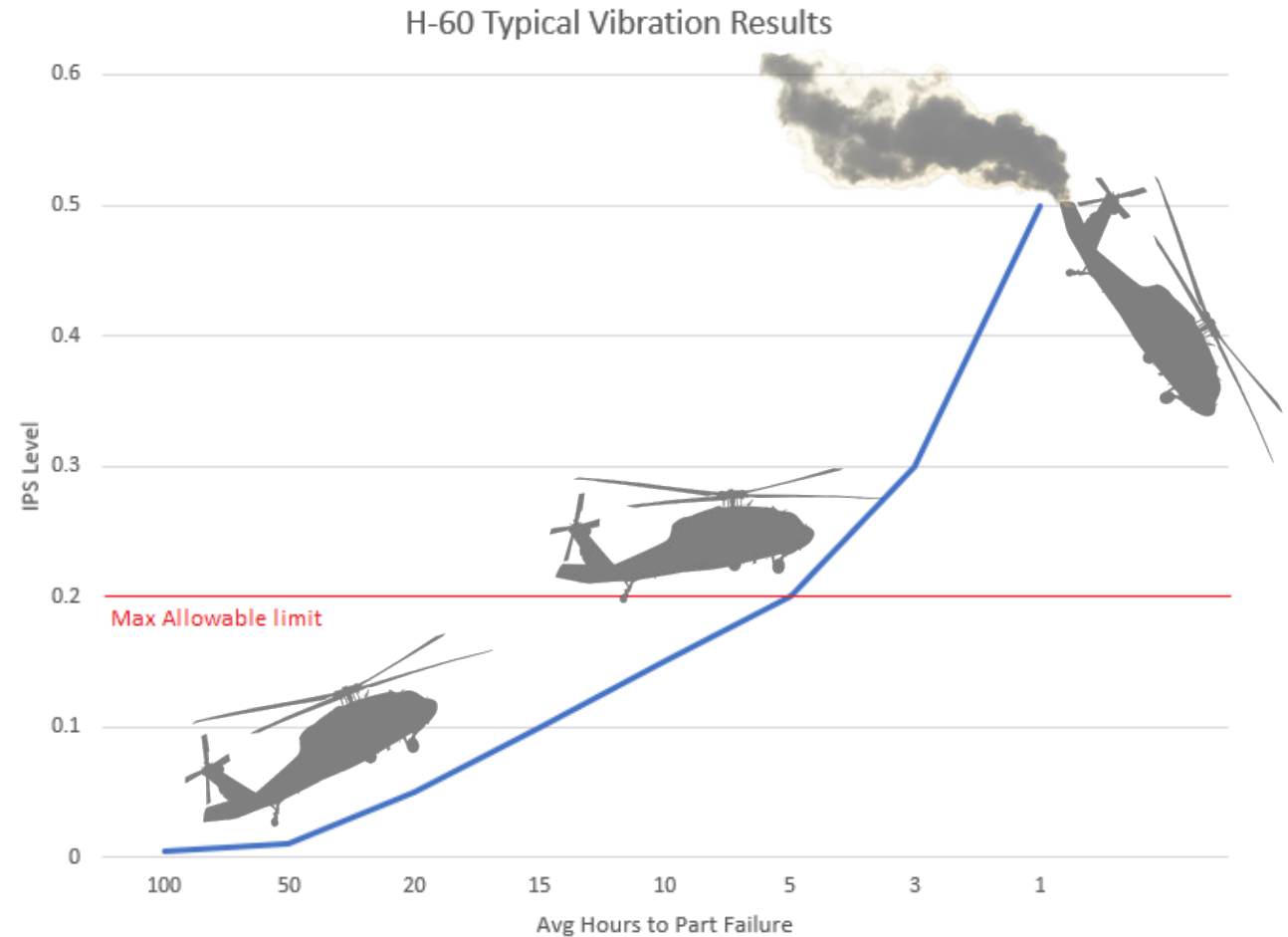
Examples of Destructive Vibration

Aviation

Standard IPS Level

0.00 – 0.09	Excellent
0.09 – 0.20	Good*
0.20 – 0.50	Bad
0.50 – 1.00	Severe
1.00 or higher	Catastrophic exponentially over time

* *Industry standard born in the 1960's due to lack of computer processing speed as well as the use of coefficients (law of averages) to solve complex balance problems*



Examples of Destructive Vibration

Typical aircraft threaded rod end on flight control rod

Excessive vibration wears outer surface of “pressed-in” ball joint causing expedited wearing to the point scaring and total separation; failure

Scaring



Worn outer surface



Examples of Destructive Vibration

Wind Turbines

- Operational and Maintenance (O&M) costs account for 20-25% of electricity production costs
- Costs may range from 10-15% with new wind turbines but increase up to 35% towards the turbine's end of life
- Cumulative O&M costs are 65-95% of the turbine's investment cost over a 20-year life with unscheduled maintenance resulting in 30-60% of the total O&M cost
- Unbalanced gearboxes and blades result in reduced power output, destructive bearing/gearbox wear, and failure of electrical components and mother boards





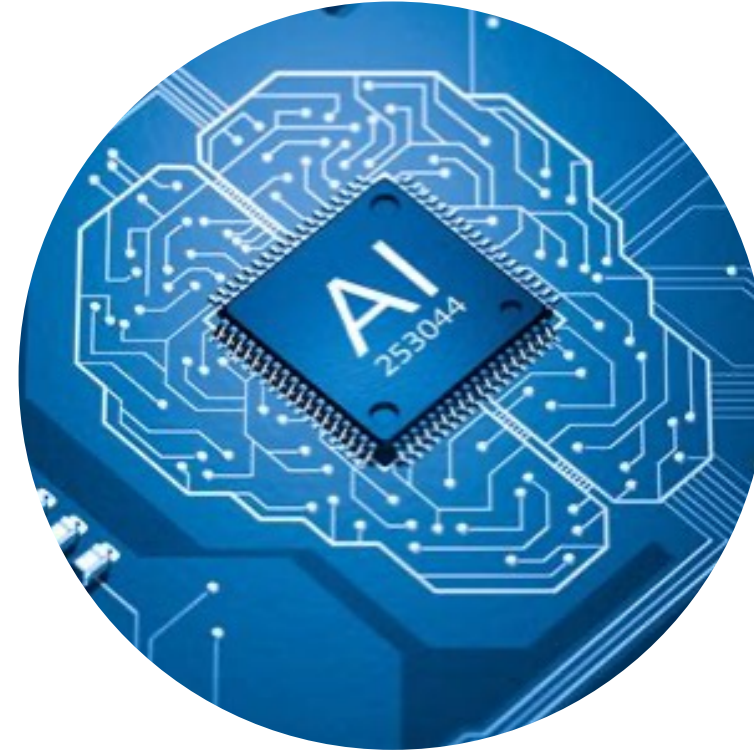
What is KULR VIBE?



What is KULR VIBE Software?

Artificial intelligence with “learning” algorithms to determine precise balance adjustments and location based on order of precedence

Historical data compiled per component, results in ever-refining of balance solutions based on actual adjustment responses (circular in nature)



Data inputs from user

- Cloud, hard wired, plug-in, or manual readings of sensors from on-board or user carry-on equipment, or over the phone
- VIBE users only need IPS level and Phase Angle (clock position or degrees) to calculate a balance solution



Strobe light used to “find” a moving blade target to illuminate the heavy side of the imbalance. Developed in the 1960’s but still in play today

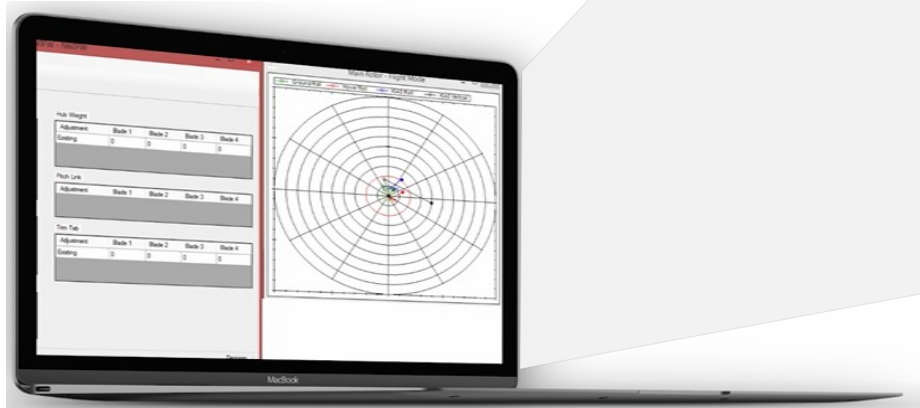


Typical carry-on equipment that plugs into aircraft to download vibration data during flight operations in the track and balance procedure

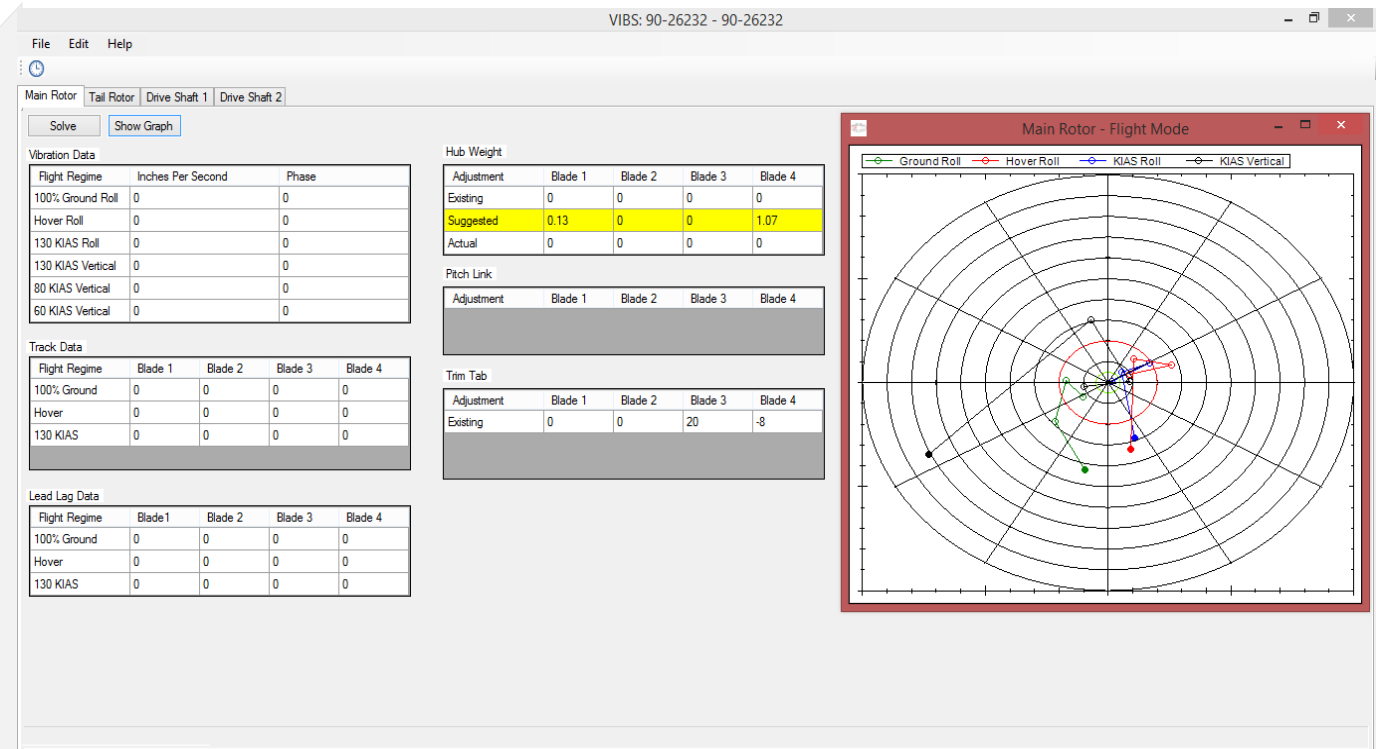
KULR VIBE Outputs

Graphical screen display

- User friendly, ONE adjustment suggestion (weight, pitch control rod, or trim tab), handheld device, over the phone or via cloud
- SAS



INTRODUCING **KULR VIBE™** | DECREASE YOUR VIBRATIONS INCREASE YOUR RELIABILITY





KULR VIBE Performance Success



KULR VIBE Performance Success



KULR VIBE for UAS (Unmanned Aerial Systems): Increase battery time and payload

Baseline				Battery Time		
Plastic, no balance				20:43		
CF, no balance				17:52		
Motor balanced, blades not balanced	Average ips	Range ips	Pull Test #	Battery Time	Increased Battery Time	
Plastic	1.7	0.98 to 2.43	2	24:43	16.20%	
CF	2.6	1.97 to 3.24	1.9	18:12	1.90%	
Motor and blades balanced	Average ips	Range ips	Pull Test #	Battery Time	Increased Battery Time	Payload Increase
Plastic	0.021	0.012 to 0.24	3	27:30	26.60%	33.40%
CF	0.09 *	0.07 to 0.1	3.1	29:09	39.60%	38.70%
Motors						
	Average ips	Range ips				
BEFORE Motor Balance (No Blades)	0.53	0.46 to 2.43				
AFTER Motor Balance (No Blades)	0.04					
Total Improvement (No Blades)	99%					

KULR VIBE Performance Success

KULR VIBE enables smooth operations and cost savings

Petroleum Helicopters

(offshore oil platform and air ambulance service under contract)

- Never missed a flight due to maintenance in more than 30 years

39th Marine Air Group, Camp Pendleton, CA

- UH-1Z Viper Aircraft written off as “unfixable”
- 78 flight hours (KULR found improper orientation of vibration sensor hiding manufacturer improper part installation of the mast bearing) saved \$39M from boneyard
- Aircraft has flown more than 150 hours since repair



KULR VIBE Performance Success

Team KULR:

On behalf of Marine Aircraft Group-39, I would like to thank you for visiting our flightline earlier this year. You helped our maintenance professionals evaluate a ground vibration issue on a US Marine Corps AH-1Z Viper Attack Helicopter that was previously diagnosed as “unsolvable”. This determination would have undoubtedly led to the aircraft’s retirement with less than two years’ service and just 80 flight hours.

MAG-39 maintenance experts had previously expended well over 2,000 maintenance hours and countless troubleshooting techniques trying to eliminate the excessive ground vibration without any success. Your team’s technical expertise, professional presentation and counsel resulted in the quick identification of the problem and a recommended maintenance path forward. These actions resulted in the helicopter’s quick return to a mission capable status and directly contributed to MAG-39 mission accomplishment.



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01 Jul 2022

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The KULR team’s contributions in returning this AH-1Z Viper to a mission capable status ensured the Marine Corps Light Attack Community does not have to retire a 39-million-dollar warfighting machine, thereby avoiding a decrease in overall mission readiness and capability. The knowledge and counsel your team shared with MAG-39 will enable the H-1 team to establish procedures to troubleshoot and head off future vibration issues. Your team’s technical expertise and counsel irrefutably contributed to MAG-39’s warfighting readiness.

Thank you for the outstanding support. We look forward to future opportunities to work with the KULR team again.

THANK YOU FOR
THE GREAT WORK!
VIB MAG

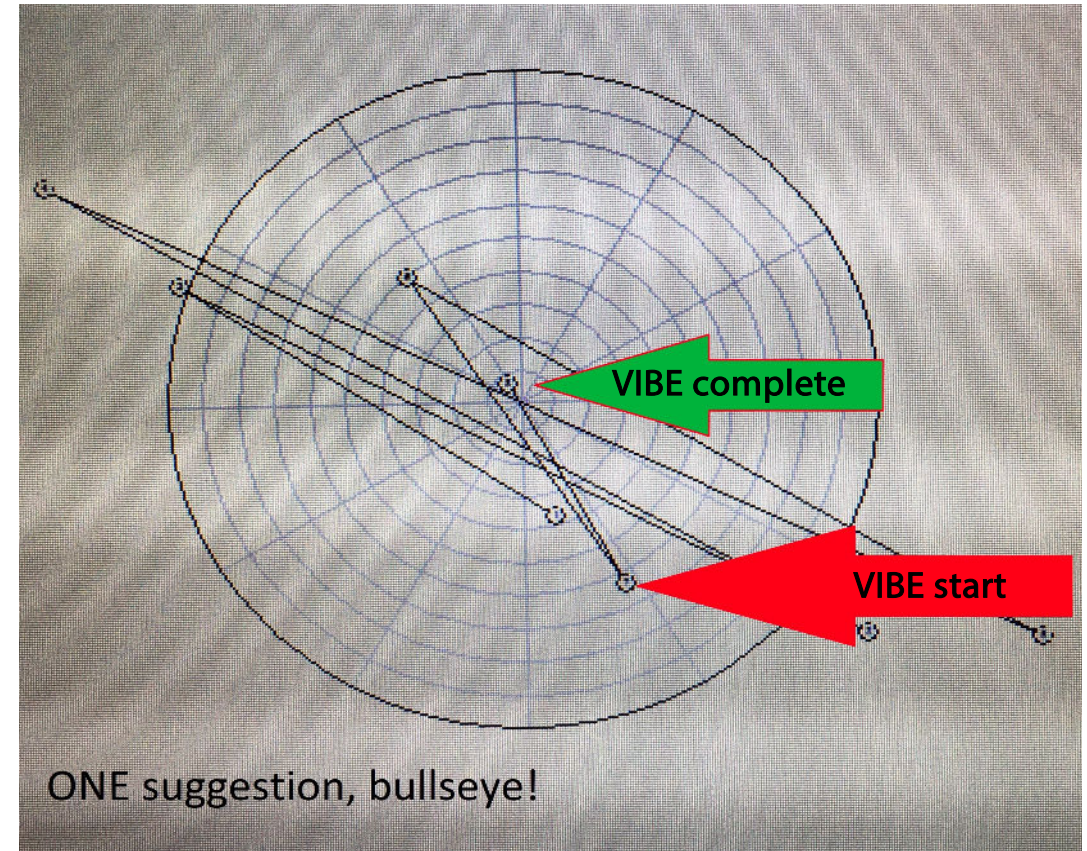
Semper Fidelis,

N.S. Marvel
Colonel, U.S. Marine Corps
Commanding Officer

KULR VIBE enables smooth operations and cost savings

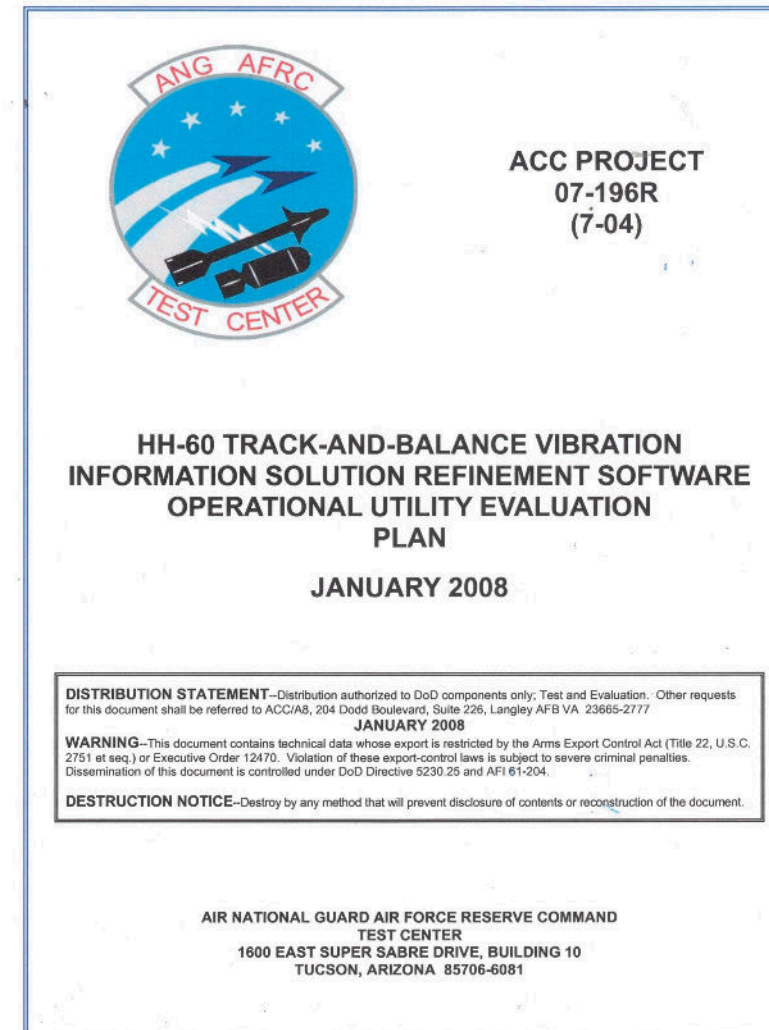
UH1 Huey failed tail rotor balance six times, we provided **ONE solution** and nailed it!

- We took their data (measurements of ips and adjustments performed) and plotted the actual polar chart prior to their next move
- They were testing our predicted solution against theirs as well as comparing our predicted solution to ACTUAL after-effects
- Their solutions did not match their actual after-effects
- VIBE software had the highest level of accuracy
- We were instantly validated with VIBE's ONE solution



USAF H-60 Operational and Utility Test of Software

- Combat proven in Afghanistan, three months no issues
- Reduction of track and balance tasks by 69%
- Average main rotor head was 0.094 IPS and tail rotor was 0.047 IPS over the 18-month test period
- Units reported significant decrease in gear box leaks, whip antennas broken off, and broken de-ice brackets
- New record set: 0.003 ips on tail rotor!
- New aircraft purchase plan resulted in shelving software purchase agreement (politics)



*KULR VIBE not affected by **extreme and austere conditions***

Extreme Weather, Alaska

Emergency call to solve elusive track and balance issue

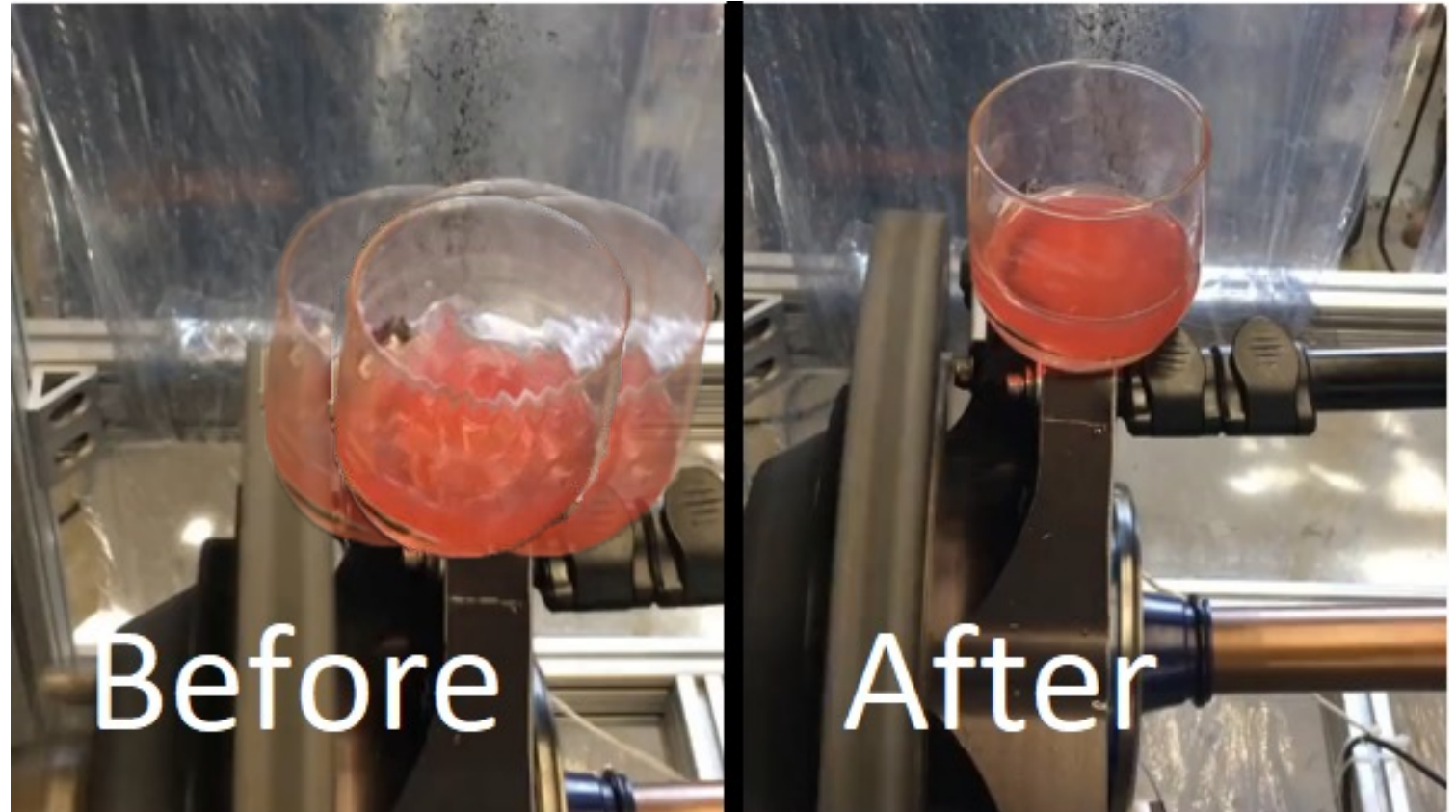
- Other software can't learn, VIBE uses AI and proprietary algorithms to "adapt" to environmental changes
- Why? Components were heating and cooling during runs, and other software could not interpolate the differences, in other words the other software was confused
- KULR VIBE was able to recognize the effect of change (sensitivity) of individual components between runs



*KULR VIBE is not new to **high performance** racing teams*

Andretti Technologies (ATEC)

- Vibration impacting driver fatigue and ability to perform at the highest level
- Balanced disc brake, hub, and axle assembly
- 2.30 ips @2,000 rpm **down** to 0.073 ips @ 3,000 rpm



KULR VIBE generates Circular Electrification of Economy

Wind Turbines

Harnessing the power of wind comes at a price when performance dictates efficiency

- Efficiency is hindered by proposed maximum rpm limits of the blades (lower rpm = lower output)
- While conducting an engineering briefing and demonstration of VIBE software and capability at Sandia Labs, NM we were told...

“...if your software does do what we have seen, it would allow us to increase our rpm from 15 to 20, then we would double kw output...” Jonathan R. White, PhD, Sandia laboratories



KULR Technology Group is building an energy management platform to accelerate the global transition to circular electrification economy:

- KULR VIBE software uses Artificial Intelligence coupled with a unique algorithm that significantly reduces vibrations that result in extended run time, increased payload capability while decreasing the degradation of critical components such as circuit boards and camera video quality.
- Target Markets: EVTOL, Helicopters, Delivery Drones, Wind Turbine, Automotive, Industrial Motors
- Combine KULR VIBE with a holistic battery thermal management and safety solution, KULR provides a platform to solve critical issues of electrification and renewable energy

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