



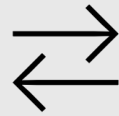
Opteran

Enabling machines to move
like natural creatures





Opteran reverse-engineers
insect brains



*providing the software mind
that enables natural
autonomy for machines*



The struggle to build adaptable machines

There are numerous problems with machine autonomy today



Environmental Structure

Require augmentation



Environmental Conditions

Intolerant to change



Environmental Dynamics

Limited responses



Job Interaction

Item constrained



Job Multi-tasking

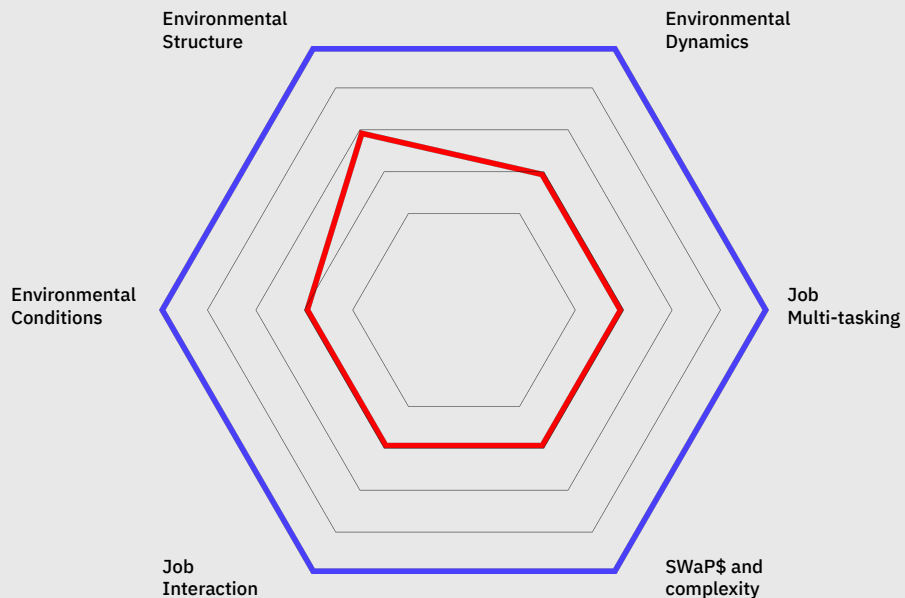
Right and managed



SWaP\$ and complexity

Inefficient

SoTA autonomy
Natural autonomy



Machine adaptability

Blue outer = nature equivalent



Two approaches to solving adaptability

Artificial Intelligence and Natural Intelligence

Artificial Intelligence / SLAM

Create human algorithms

Engineer-derived algorithms and caricatures of biological neural systems with limited training

Deep/Machine Learning
data / compute

How humans solve autonomy

‘we’re trying to make it work’

Natural Intelligence

Extract nature's algorithms

Evolution of natural algorithms through billions of years of massively parallel training

Computational Neuroscience
brains / biology

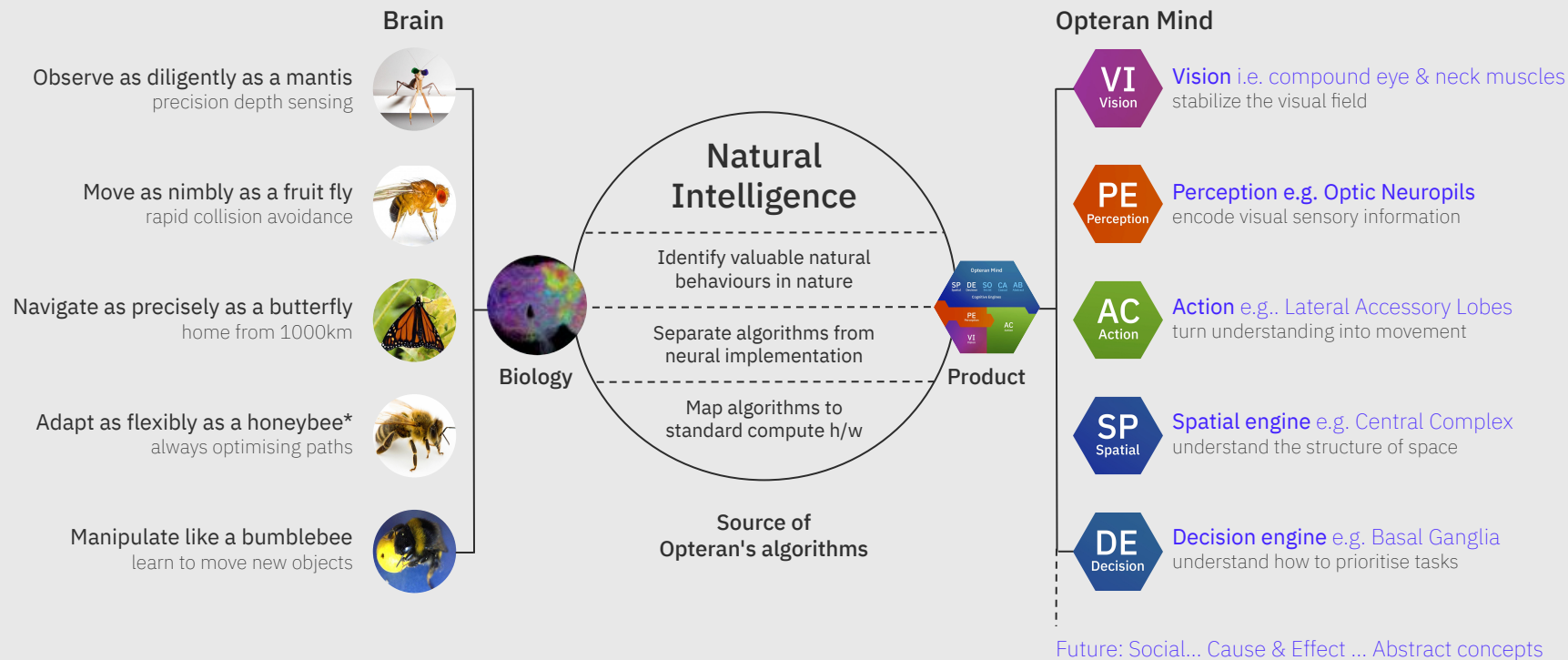
How nature solved autonomy

‘we know it works’



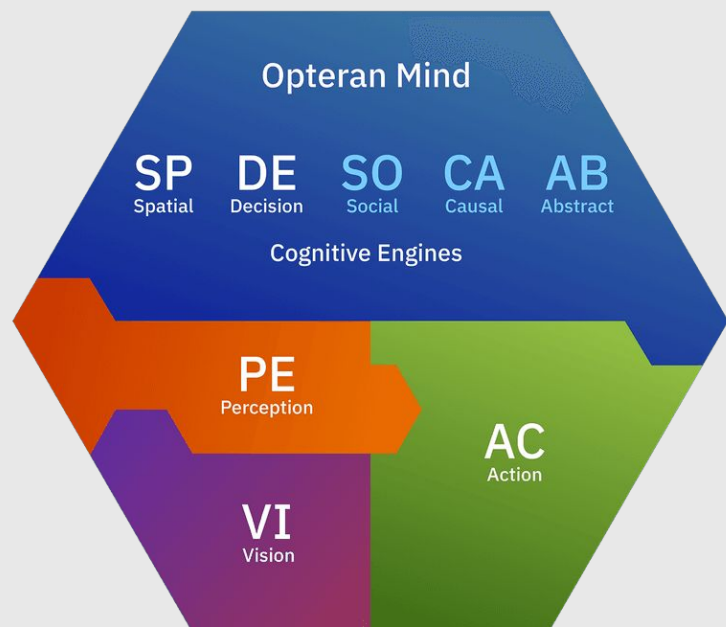
Opteran reverse-engineers nature's solution

Real brains evolved naturally adaptable algorithms that solve hard autonomy problems



Opteran Mind [4.1] product release

General purpose autonomy software to enable highly adaptable machines



Opteran Mind

Light up your mind release



Opteran Vision

360 degrees of algorithmically stabilized vision



Opteran Perception

Tolerant to dynamic lighting, dirt and adverse weather



Opteran Action [Release 5.0+]: Collision prediction & avoidance

Depth perception for small static and dynamic objects

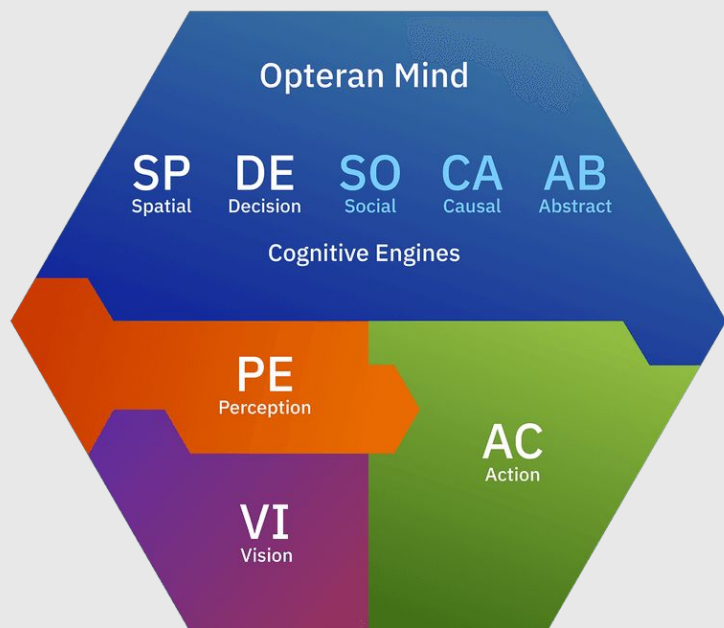


Opteran Spatial Engine: Mapping & navigation

GPS-free, VIO, & ultra-low memory localization & mapping (1KB/m2)

Differentiating your product in today's market

Working where traditional SLAM fails whilst slashing your BoM



#1 – Increase Robustness & Efficiency

GPS-free

Massive maps, join & extend

One shot map learning + loop-c

Scene change

Featureless & aliased spaces

Confined spaces

Re-routing / self-healing

Consistent & variable lighting

Indoor & outdoor vision

Poor weather & dirt

Blinding

Reflections

Kidnapped robot

Small static / dynamic objects**

Verifiable algorithms

Ultra-low memory maps (1KB/m2)

360 FoV, high FPS (90), no buffering

Algorithmically stabilized (3DoF only)

Sustainable (10x < CO2 than training 1 neural net)

#2 – Whilst reducing your BoM

Edge only & network free

Lowest cost 2D CMOS cameras only*

Ultra-low compute on CPU/FPGA/ASIC

Simple pre-integrated system

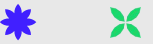
Standards based (ROS/Mavlink/PX4)

Opteran Mind: SLAM problems solved!

Our software delivers a step change in robustness and deployment cost





	Product KPI (based on customer dialogues)	Opteran	Opteran vs competitors			How we differentiate your AMR?
			2D Lidar	3D Lidar	vSLAM	
Improved real world robustness	Localization accuracy	2cm (confined area); 5cm (open area)	Stronger	Same	Same	Diversify your existing localisation and mapping system reducing downtime and expand the environments that an AMR can operate in
	Scene Change	30% operating but works up to 60%	Much stronger	Stronger	Stronger	
	Variable Lighting Range	Localise robustly in lighting between 20 to 3000 Lux with blinding	Same	Same	Much stronger	
	Blinding and reflections	Localise robustly around glare, glass and mirrors	Much stronger	Much stronger	Much stronger	
	Aliased environments	Localise robustly in aliased environments	Much stronger	Stronger	Much stronger	
	Edge compute	Lightweight and efficient algorithms; no cloud dependency for operation	Stronger	Much stronger	Much stronger	
Radically lower total cost	BOM cost	Runs on low cost hardware with mature supply chains	Stronger	Much stronger	Much stronger	Reduce the time and cost of deployment making it easier to scale
	Set up cost	No infrastructure & single shot map learning; speed to map 1m / second	Stronger	Much stronger	Much stronger	
	Maintenance cost	Extend & update maps with no processing	Stronger	Much stronger	Much stronger	



Opteran Mind: SLAM problems solved!

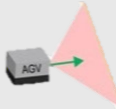

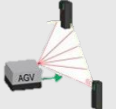

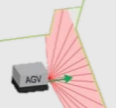

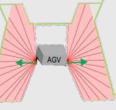

Release 4.1 is differentiated

 Opteran USP
 Parity

Product KPI	Opteran Mind Release [4.1] metrics	Typical SLAM Average metrics	What does this mean? Your system
Localization accuracy (confined area)	2cm everywhere	2cm	Parity with SLAM and often better
Localization accuracy (open area)	5cm everywhere	5-10cm	Parity with SLAM and often better
Bearing Accuracy	1 Degree	1 Degree	Parity with SLAM and often better
Smoothness of Operation	Smooth Trajectories Across Path	Smooth Trajectories Across Path	The system “feels” confident
Operating Environment	Warehouse with external lighting	Warehouse but skylights and loading bays cause vSLAM problems	Addresses glass reflections and perspex
Scene Change	30% operating (but worked up to 60%)	Major scene change requires remapping entire facilities	Addresses a fundamental SLAM issue
Variable Lighting Range	20 to 3000 Lux operating (but tested to more i.e. near park)	vSLAM can't do, a key customer pain	Addresses a fundamental vSLAM issue
Map Size	1kb per square meter (unlimited map size)	20-100s of Mb per square meter requiring large compute to process	Real time mapping of large maps with low compute needed vs. days

Opteran Mind: SLAM problems solved!

A new paradigm in spatial localization, mapping & navigation

	Input		Map building		Localisation	Robust navigation	
	Data input	How it works	Integration	Compute	How it works	Scene & light robustness	Remap complexity
Visual SLAM BOM cost¹: \$2k - \$7k	Narrow tightly calibrated view at moderate fps 	Encode specific features from the scene	High	Medium 	Compare current features to stored features to determine position	X Scene and lighting changes lead to map drift / mis-localisation	Low
2D LiDAR BOM cost²: ~\$2k	Panoramic 2D plane of points at low scan rates 	Encode data into simple 2D occupancy map	Med	Low 	Compare current sensor data on landmarks to map to determine position	X Scene changes require re-mapping to avoid mis-localisation	Med
3D LiDAR BOM cost³: \$8k - \$27k	Panoramic 3D point cloud at low scan rates 	Post-process data into high resolution map after mapping	High	High 	Compare current sensor data on landmarks to high resolution map to determine position	X Scene changes require re-mapping to avoid mis-localisation	High
Opteran Mind BOM cost: <\$160	Panoramic view: robust to loose calibration at high fps 	Encode 360° FoV into tiny fingerprint	Low	Low 	Compare current 360 degree fingerprint to stored fingerprints to determine position	✓ Robust to substantial changes in lighting and scene	Low

Case studies

Naturally Autonomous Robot



US Small Logistics AMR

Building small AMR to distribute to Operators on the line

Japanese Shopping Center AMR

Helping the elderly move good around center and to car park

EU Logistics AMR

Navigation around warehouse with scene change and lighting issues

Indoor Drone

Navigation and collision avoidance indoor consumer

Autonomous Vehicle



Case study

Drone pipe inspection in Oil and Gas



Challenge for pipe inspection in hazardous environments

- Huge problem with inspecting corroded pipes in hard-to-reach areas
- Inspection scaffolding takes weeks to erect and costs millions per year
- Dangerous and risky activity for human inspectors
- Manually piloted drones require expensive very skilled operators
- Automated systems fail due to environmental challenges (no-GPS, blinding, wind, aliasing, etc)

Tested in former steel mill

- GPS denied environment
- Very low light (~20 lux)
- Aliased, complex piping
- Large featureless spaces (20m x 20m x 100m)
- Confined spaces (<1m)
- Lots of dust & dirt

Result achieved by Opteran Mind*

- 10x less drift than existing market flight assist solutions
- Smooth flight vs. unpredictable and extreme movements

“The results of your testing are very impressive... this is much smoother than our existing solution. We’re looking forward to getting our hands on it!” – Lead Research Engineer



Case study

Autonomous Mobile Robot (AMR)



Systems not stable, expensive h/w that fails; constant downtime

- Localization errors (1-10 mins/machine across 100s = massive downtime)
- Aliasing is a problem for LiDAR; row of docking stations all look the same
- Changing environment, docking station move, pallets stacked
- Movement of trolleys in warehouse creates scene change
- Dynamic lighting day/night creates issues
- Handling dust and dirt, warehouse very dusty
- Lots problems over ramps: 3% incline but can be upto 10% over 40-50m
- Relocalization can't be done remotely
- Getting skewed maps as issues closing loop

Tested in warehouse

- GPS denied environment
- Dynamic lighting range
- Large featureless and aliased spaces
- Movement of boxes and trolleys



Result achieved by Opteran Mind*

- Accurate localization
- Re localization of robots removed from map
- Dynamic lighting did not disrupt localization and navigation
- Worked with blinding into lens from torches
- Ramps worked

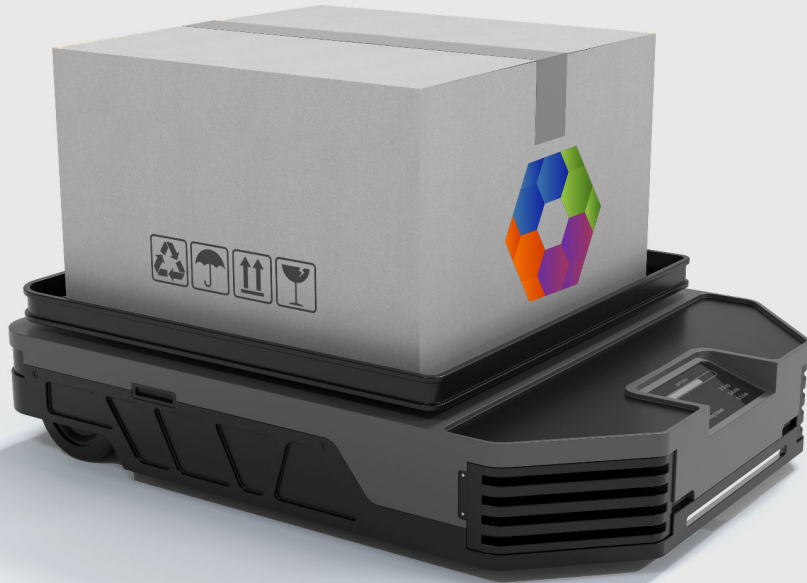
Zero failures!

“We see a lot & have never seen anything like this... your the most amazing company we've seen in the last couple of years... it's too good to be true” – CEO AMR company

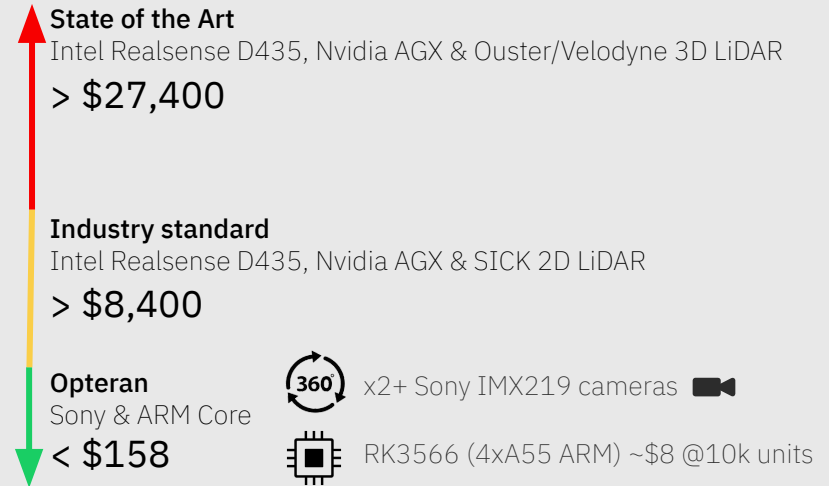
Launch of a new Opteran based AMR at a major industry show

Opteran cost model

Slashing integration and BoM cost to increase margin and profitability



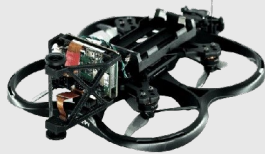




Sensor, compute & integration cost

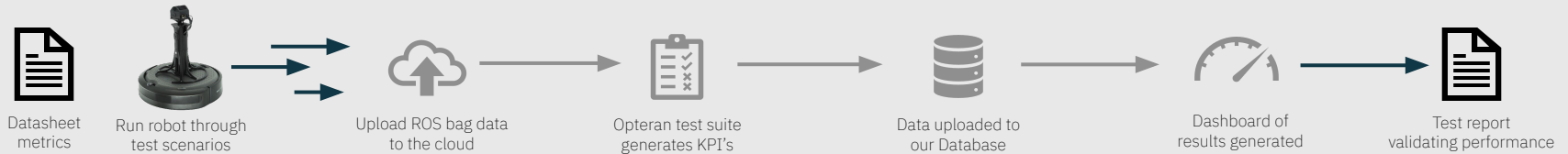


Opteran Mind testing & validation

Supporting you in rapidly and simply evaluating the product

Virtual testing software in the Loop	Real-world testing on pre-built reference machines			Test your own system integrated h/w systems
<p>Simulation engine</p> 	<p>Dog <u>(video)</u></p> 	<p>Drone <u>(video)</u></p> 	<p>AMR <u>(video)</u></p> 	<p>Opteran Development Kit</p> 

Upload ROS bags to Opteran Validation Suite to instantly validate results:





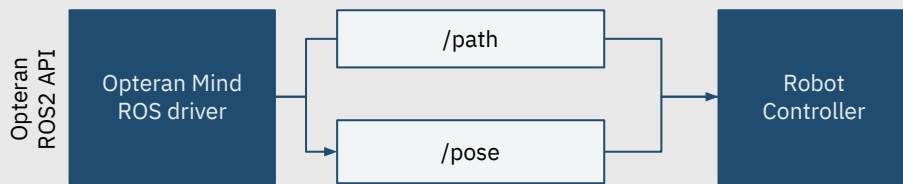
Integrate Opteran Mind with standards

Our science may be fundamentally different, though our interfaces are standard

A single integrated autonomy stack that does not require integration with data centre capture, storage or processing

Choose cameras & silicon from your hardware suppliers, leveraging economies of scale

Integrate with industry standards and familiar APIs:



Opteran licence model

How our licence is designed to fit with your business model

Licence fee

One-off **upfront IP licence** for the right to use our patented technology

Licence royalties

Software licence fees tailored to your revenue model e.g., ASP* or SaaS*

Support & maintenance fees

Support & maintenance services for bug fixing, technical advice & software upgrades

Non-recurring engineering fees

NRE for integration and bespoke design services to embed our technology



Recognition for our scientific achievement

Investors, news, awards and recognition



[BBC](#) programme on Opteran, [UK Research Institute background story](#), [Wired](#) 6 Science and Technology trends to Change the World plus AAAS [Science Robotics](#) whitepaper



Intelligence isn't artificial. Intelligence is natural

Thank you!

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