EMBARK

NASDAQ: EMBK

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EMBARK Snapshot: Focused, Pragmatic, Consistent and Disciplined

Summary Overview of Embark

- *Embark is America's **longest running self-driving truck program**[(1)]*
- *Embark is is an Autonomous Vehicle SaaS Company **focused on trucking***
- ***Focus on trucking** since Embark's founding critical to the technology development and go-to-market strategy*
- ***Asset-Light** strategy focused on **partnering** across the ecosystem in a manner how the trucking market operates today: suppliers, carriers & shippers, real estate*
- *Proprietary Vision Map Fusion technology **updates the map in real-time**[(2)] allowing the Embark Driver software to detect and respond to new situations where the map may be outdated, **improving safety** and enhancing the expansion of Embark's ODD[(3)]*
- ***Embark Universal Interface (EUI)** technology allows for Embark's software to be platform and OEM agnostic*
- *Embark **partners with carriers** (and private fleets), who pay a per-mile subscription fee for Embark's software – eliminating channel conflict with carriers and in **close coordination with shippers***
- *Carriers will deploy trucks autonomously between highway-adjacent sites called **1) Transfer Points** on Embark's coverage map or **2) Direct-to-Customer** sites*
- *Expected commercial operations at scale in the sunbelt in **2024** and remainder of the lower 48 in **2026***

(1) *Based on regular road-testing of self-driving truck technology on public roads in the United States.*
(2) *Vision Map Fusion leverages Embark's cutting-edge non-linear-optimization techniques to update the map in real-time using detailed road geometry data from Embark's LiDAR and Camera sensors.*
(3) *Operational design domain.*

Simplifying a Complex Problem

Autonomous driving has inherent constraints depending on the type of driving which is solved for, as well as the vehicle to be used – Both factors were fundamental in driving engineering decisions for Embark

Constraints of the Problem

Highway driving

- **Detection and Fusion** range requirements are extremely high
- **Geographic coverage** is needed across the US due to long driving distances

City driving

- **Driving environment** is extremely complex to understand
- **HD maps** are needed due to the unstructured conditions – But are brittle and require updates
- **Edge cases** are encountered frequently and create challenges in planning

AV Trucks

- **Sensors** are negatively impacted by a high degree of cab motion
- **Vehicle control** is more difficult to model and address (truck is wider in lane, trailer has variations in weight, speed is high)

AV Cars

- **Unit economics** limit the financial budget for latest and greatest sensors and compute
- **Vehicle Dimensions and Power** restrict system size, power and viewing angles, limiting potential functionality

Embark's Approach

Company DNA

- **Focus** development on the smallest set of capabilities necessary to deploy a safe commercial product
- **Engineering team** made of functional leaders in robotics, complemented by academia – product delivery mindset
- **Purposeful in partnering** wherever expertise exists outside of our core

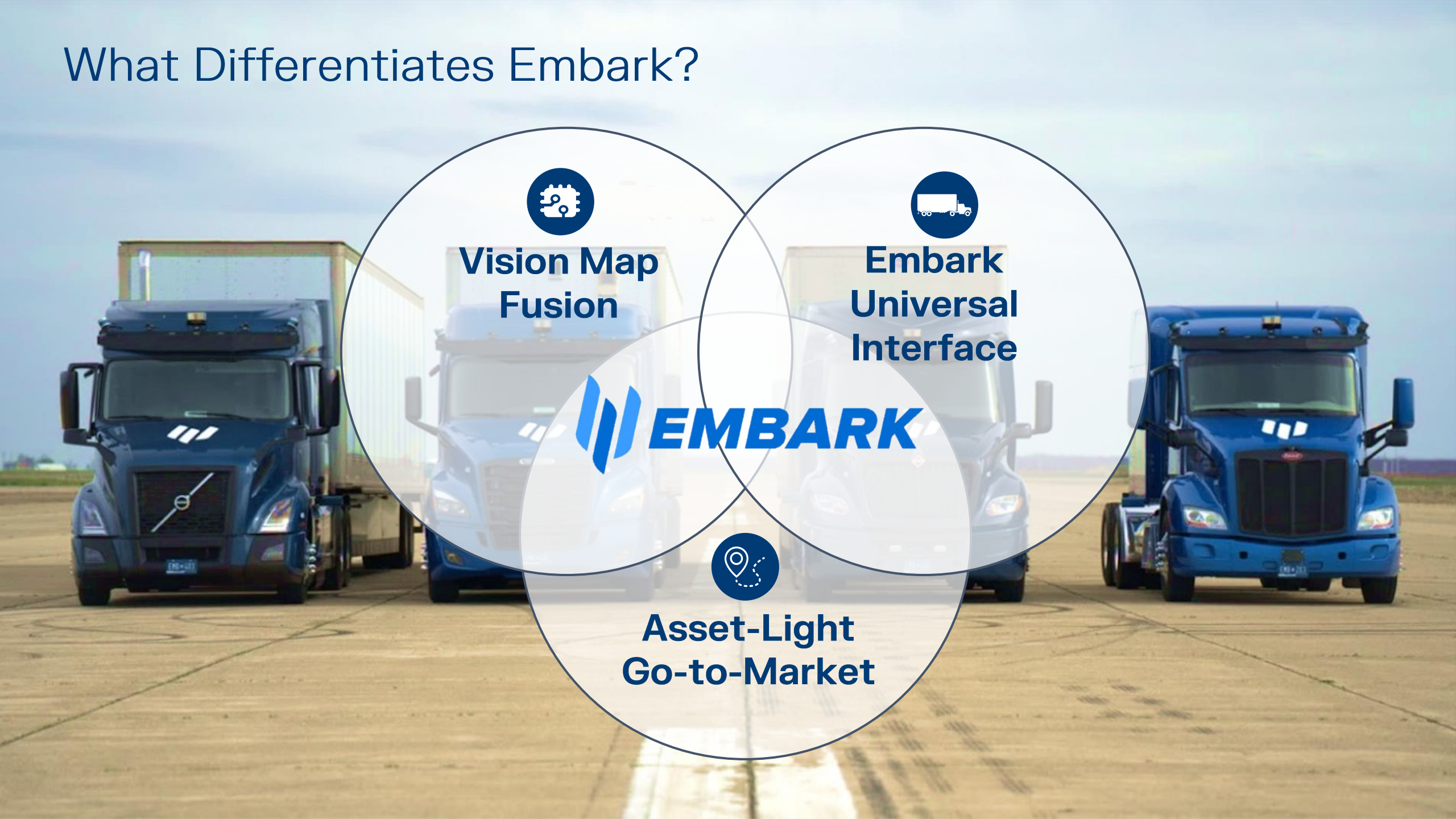
Engineering Decisions

- **Reduce reliance on maps** through dynamically fusing sensors and map data
- **Invested early in active learning** to enable scalable deep learning with a fraction of the team, budget, and time
- **Coupled prediction and planning** together to model how our actions impact others

Go-to-Market Strategy

- **Focused exclusively on trucking** since day one
- **OEM and supplier agnostic** – We have optimized our AV solution to work with any of the four major OEMs
- **Partnered with Carriers** to jointly build the operating model, without directly competing with incumbents

What Differentiates Embark?



Vision Map Fusion

What is Vision Map Fusion?

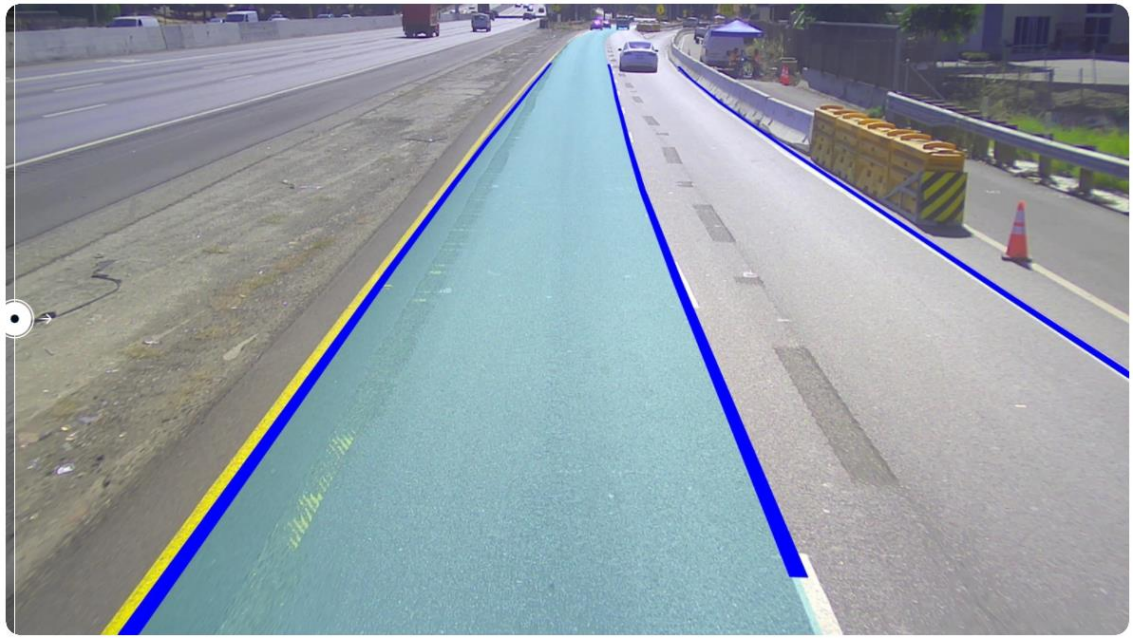
- Vision Map Fusion is Embark's differentiated approach to mapping
- Embark does not treat the map as static, but rather treats the map as a dynamic changing environment
    - Legacy AV systems rely on HD mapping given focus on the robotaxi market or generally accepted practice of building a first-generation system
- Vision Map Fusion leverages Embark's cutting-edge non-linear-optimization techniques to update the map in real-time using detailed road geometry data from Embark's LiDAR and Camera sensors
- This allows the Embark Driver software to detect and respond to new situations where the map may be outdated and improves the safety of the system
- This technology should also enhance the expansion of Embark's operational design domain for situations like snow, where lack of lane markings or lane closures due to inclement weather are common challenges
- Vision Map Fusion was designed for trucking given the lack of re-routing capability for highway driving and may not be as applicable for urban driving
- Vision Map Fusion has been a key catalyst to carrier partnerships given deep understanding of highway construction frequency

Real World Example

The images below show a truck driven by the Embark Driver encountering a common highway occurrence: lanes have been repainted in a new location as a result of construction. Pre-construction lane lines are still visible on the road, while newly painted lines have shifted the lanes to the left by a significant degree.

Vision Map Fusion View

Embark Driver is using VMF to automatically update the map in real time as it travels down the road. Because of this, lane lines closer to the truck are highly accurate, while lane lines farther away still rely more heavily on the map until they are "healed" by VMF.



Embark Universal Interface

What is Embark Universal Interface ("EUI")?

- EUI is a standard sensor module and compute module designed to interface with most major steering and braking actuators
- Comprised of cameras, lidars, radars, and GPS in order to perceive the world around the trucks and enable safe autonomous driving
- EUI is intended to enable Embark's carrier partners to purchase Embark Driver-compatible vehicles from multiple OEM integrators
  - Nearly 90% of top 25 carriers run 2+ OEMs and ~50% run 3+ OEMs[1]
  - Embark's PDP partners currently run all 4 major OEMs
- Intended to be integrated with variety of powertrain and propulsion systems
- Designed to be consistent with the way the trucking and logistics industry operates today
- Designed to be a factory option for carriers
- EUI cost intended to be bundled into truck cost, paid for by carriers and their customers

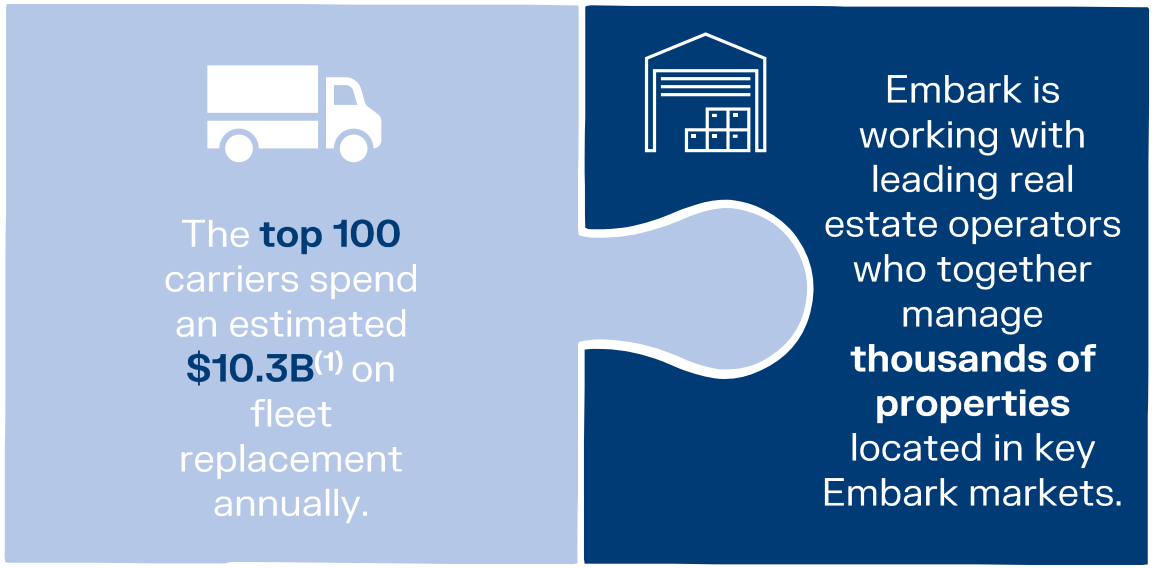
1) *Fleet OEM composition based on company analysis of publicly available media and disclosures.*

Asset Light Go-To-Market Strategy

What is Embark's Asset-Light Go-to-Market Strategy?

- Embark will commercialize its technology in a manner that is consistent with how the trucking and logistics industry already operates today
- Embark's customers are the carriers, who may license Embark's technology for a per mile subscription fee
  - Embark does not build trucks and does not intend to create its own carrier network
- In-depth network analysis with current carrier partners designed to bring the technology to market at a commercial scale
  - Leverage the carriers' capital spend and economies of scale with OEMs to enhance the overall ecosystem in a capital efficient manner
- Work with Tier I suppliers to integrate and work with OEMs, consistent with the way trucks are built today
- Embark will partner with industrial REITs to access properties through a mixture of traditional and flexible lease structures that provide fleet partners the transfer points they need to operate nationwide

Complementary Asset Partnerships



Robust Partnership Model Allows Embark to Remain Asset-Light, Focus on on its Core Competency of Software Development and Leverage the Today's Existing Ecosystem.

1) *Replacement figure based on the total fleet of the top 100 carriers (https://www.ttnews.com/top100/for-hire/2021) and assumes 25% of the total fleet is replaced annually at $125k replacement value per truck.*

How to Measure Our Progress

Technology Development

Past Technology Milestones and Accomplishments (11 of 16)

2016	Bought First Truck
2017	Lane Keeping and Lane Changes
2018	Cut-ins, Merges, Vehicles on Shoulder
2019	Night Driving and Surface Streets
2020	Stop and Go and Remote Monitoring
2021	Inclement weather (excluding Snow) and Construction

5 Remaining Technology Milestones to Accomplish

2022	• Emergency Vehicle Interactions • Evasive Maneuvers
2023	• Blown Tires • Safely Pull Over to Shoulder • Inspections

Commercial Progress

1 Partner Development Program Reservations

Demonstrating Demand - Industry leading 14,200 truck reservations

What to Expect in 2022?

- Growth in truck reservations
- Pilots to demonstrate capabilities to commercialize
- New partnerships with leading carriers & shippers

2 Manufacturing Partners to Enable Embark Universal Interface (EUI) as an Option

Partnering to integrate Embark technology and enable shippers and carriers to order EUI-compatible trucks

What to Expect in 2022?

- Close integration with existing partners
- New partnerships

3 Coverage Map Expansion

Expanding the Coverage Map – Texas location & routes

What to Expect in 2022?

- Demonstration of fleet services at transfer points
- Expansion of coverage map
- New real estate partnerships

Key Business Updates

Commercial Partnerships	Industry leading 14,200 truck reservations Partnership with Ryder to add up to 100 transfer points to Embark's ecosystem
Supplier Partnerships	Partnerships across sensors, computing, steering, powertrain and more to support cross-platform integration for Embark Universal Interface
Pilots	Piloting electric trucks for first and last mile with and
Corporate	Expanded into Texas with a new autonomous trucking facility in Houston and launched a new autonomous trucking lane between Houston and San Antonio
Conferences	**January:** Morgan Stanley Auto 2.0, Needham Virtual Growth, Manifest 2022, Baird Vehicle Technology & Mobility **Upcoming:** Stifel Transportation & Logistics, Citi Industrial Tech & Mobility, Cowen Mobility Disruption, KeyBanc Emerging Technology Summit, JPM Industrials, BofA STAARs Summit
Press	Jan 14th Freightwaves coverage of Embark's technical roadmap to navigate snowy conditions Jan 21st Medium post outlining Embark's practical IP strategy

Concluding Perspectives

	Focused on a market with a clear commercial and business use-case: commercialization is expected in the near-term and tangible
	Disciplined, consistent focus from the start on AV trucking, which has enhanced technology leadership
	Commitment to building a product that places the safety of its end users as its top priority
	Partnership model allows Embark to focus on core competency of software development and deploy its capital efficiently
	Embark seeks to enhance and help evolve the overall industry, not disrupt or break the industry

EMBARK

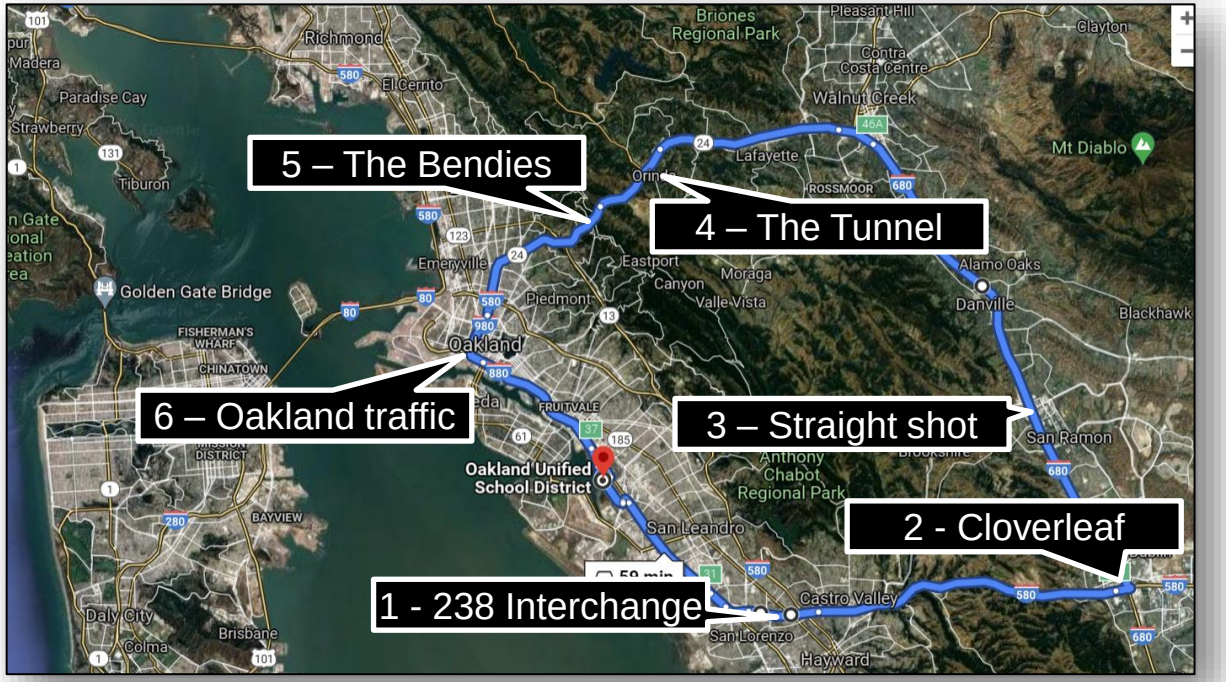
Appendix: Demo Detail

The Oakland Loop – Driving Maneuvers in Complex Situations

The Oakland Loop was identified to subject the Embark Driver to situations that would typically take 1000s of open-road miles to encounter, enabling participants to witness the full breadth of the system's capabilities.

Oakland Loop Demo Route Overview

Overview - 56 Miles, surface street driving, highway driving, stop-and-go speeds, heavy traffic, requires merging in both directions, tunnel/bridge lighting requires sensor modality

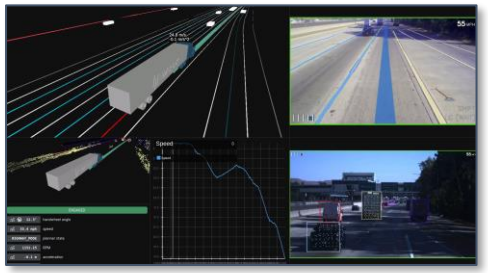


Oakland Loop Summary Overview

1. **238 Interchange**
   - Must accelerate and enter flow of traffic
   - Urgency required for lane change due to limited "runway"
2. **The Cloverleaf**
   - Need to recognize the road geometry
   - Cloverleaf presents a banked tight turning radius for truck
   - Subsequently, system encounters an unmarked road segment, engaging VMF to estimate path
3. **Straight Shot**
   - Normal driving
4. **The Tunnel**
   - Without GPS, need to rely on updating localization position purely based on odometry and sensor measurements
   - Lighting conditions change suddenly from very dark to very bright
5. **The Bendies**
   - Banked declines make mapping difficult/unreliable, VMF used to address this
   - Tight curves test lane centering capabilities
   - Requires use of engine brakes for a smooth ride downhill
6. **Oakland Traffic**
   - Multiple difficult merges with high traffic
   - Several lane changes with tight timelines
   - Frequent stop & go leads to cut-ins

Embark Driving Maneuvers (1/5) – Navigating a Cloverleaf

Cloverleaf



[Full Video Here]

1.Sensors

- Cloverleaf turn and higher elevation reduces view of sensors

2. Detection and Fusion

- No vehicles are detected in lane
- System identifies upcoming cloverleaf
- Current trajectory and speed to be impacted by turn

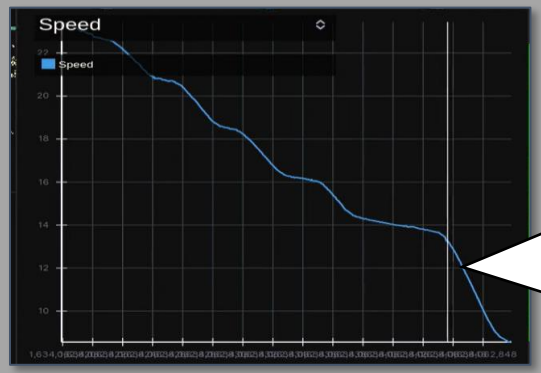
3. Prediction and Planning

- Embark must slow down to prepare for cloverleaf
- Steering must adjust for the trailer's impact on turning radius

4. Controls

- Curve in road considered
- High fidelity model optimizes trajectory
- Accurate and smooth turning initiated

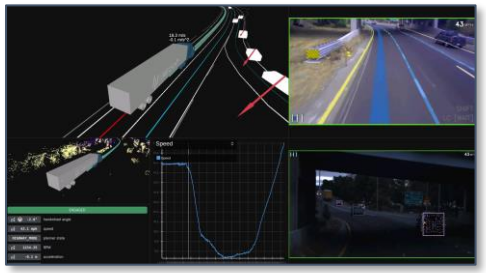
- Vehicle is entering cloverleaf
- Current trajectory shifts in lane to account for trailer



- Speed steadily slowed down in advance of the turn
- 18 MPH around tightest curve

Embark Driving Maneuvers (2/5) – Tunnel + Lane Change

Tunnel



Full Video Here

1.Sensors

- Tunnel impacts the normal operations of the sensors
- Embark Driver software must change its weighting and rules to account for this

2. Detection and Fusion

- Radar output often gives false positives from tunnel
- GPS no longer gives accurate position

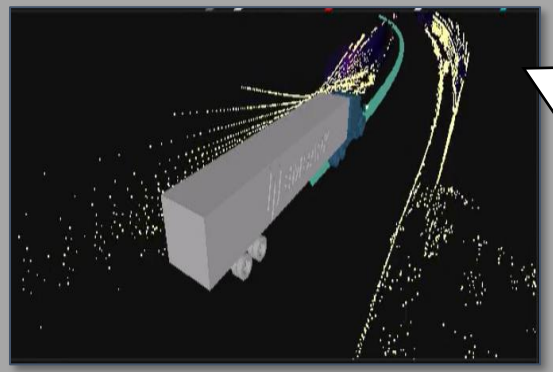
3. Prediction and Planning

- Vision Map Fusion accounts for the impact of tunnels on radar + GPS
- Embark's lane planning resulted in being in the left lane ahead of the tunnel

4. Controls

- Speed reduced to account for tunnel + slight left turn
- Lane change was not initiated until the truck was on a straight road post the tunnel

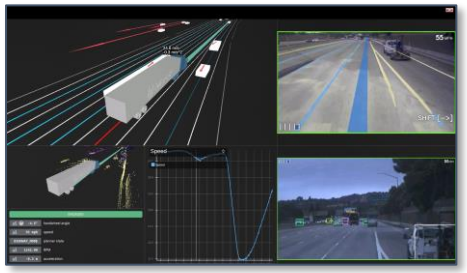
- Cameras cannot initially see into the tunnel
- Cameras will need to adjust for lower light conditions



- Lidar has returns much closer than normal
- Radar often creates false positives from the tunnel

Embark Driving Maneuvers (3/5) – Braking + Aggressive Cut-in

Cut-in



[Full Video Here]

1.Sensors

- All sensors are tracking multiple objects
- 4 lane highway (in each direction)
- Traffic is free ahead, but busier behind of the truck

2. Detection and Fusion

- Passing truck is to the left of Embark
- Multiple vehicles will be entering highway and merging from the right

3. Prediction and Planning

- Limited options are available to change lanes
- Embark can change speed, and shift in lane
- Merging behavior is often erratic from drivers

4. Controls

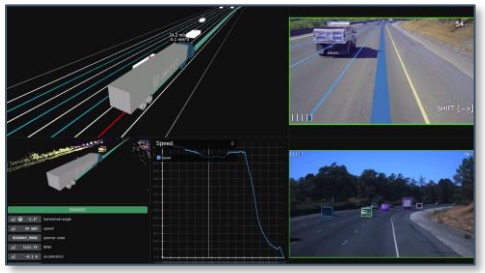
- Shifts in lane to give pickup more room
- Brakes are gently used, followed by a smooth acceleration

- Pickup with a trailer is merging onto the highway
- Pickup is considerably slower than traffic

- Embark lane change was prevented by truck to the left
- Pickup waited to merge until it was directly in front of Embark

Embark Driving Maneuvers (4/5) – VOS + Shifting

VOS + Shifting



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1.Sensors

- Long Range LIDAR first identifies object on shoulder
- Object cannot yet be seen by other sensors
- Subsequently, camera identifies VOS

2. Detection and Fusion

- Object identified to have zero velocity, and may have pedestrians nearby
- LiDAR hypothesis is prioritized over other sensors as VOS has higher degree of risk

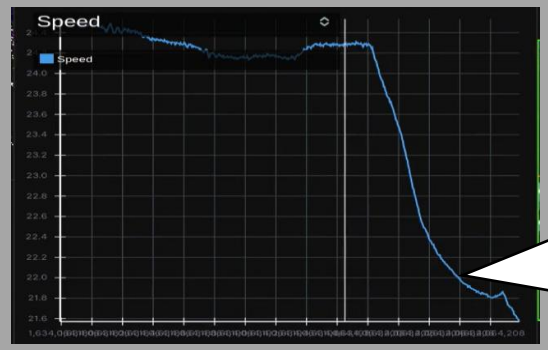
3. Prediction and Planning

- Reaction time for VOS is reduced due to a large difference in velocity between VOS and truck
- Risk to VOS is reduced if the truck changes lane or shifts in lane

4. Controls

- A vehicle to the left of the truck prevents a lane change
- Minimum risk maneuver is shifting in lane

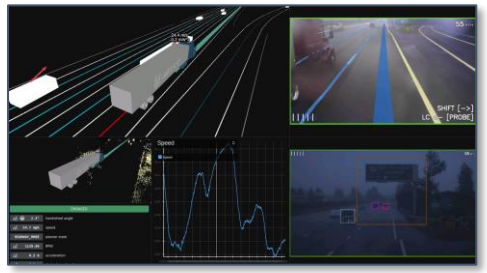
- VOS recognized
- "Red" box differentiates object
- Embark takes VOS actions



- Truck must follow regulation for VOS
- Truck slows down
- Truck shifts in lane to left

Embark Driving Maneuvers (5/5) – Heavy Rain + Merging

Driving in Rain



Full Video Here

1.Sensors

- Cameras can have reduced resolution and/or be blinded
- Radar can create false positives (e.g., rain splash = car)
- LiDAR range decreases as reflectivity reduced

2. Detection and Fusion

- Sensors no longer agree – Conflicting inputs
- Fusion must change weights of model
- Radar filtered to remove splash, Bias increases towards LiDAR

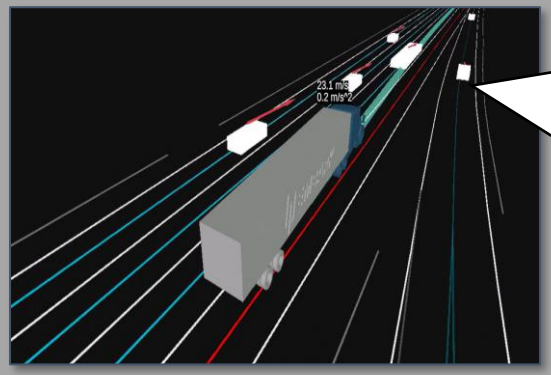
3. Prediction and Planning

- Car is merging onto the highway and into the Embark's current lane
- Lane change to the left planned, while tracking an adjacent truck which just passed

4. Controls

- Inputs to pedal, brake and steering impacted by rain
- Change accounting for reduced grip and slower braking is needed based on rain conditions

- Camera is significantly impacted by the rain
- Most vehicles cannot be recognized by the camera



- Merging vehicle into current lane
- Lane change was performed after another truck passed