**Friday Podcasts**

Name: Sanjay Jagadeesh

**Episode Title:** “iMerit – Radha Basu” **Podcast:** *Autonomous Vehicles* **Date:** Aug. 5, 2021

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| **Headings** (after)  World of Avs (data)  What iMerit does.  Working with AV data  iMerit using this data  Edge cases  Dynamic data (libraries)  5 steps  Data challenges  Non-data challenges  What will future work will be on?  Inclusive workforce | **Notes** (during)  (See Outline of Episode below before taking notes.)  Autonomous mobility as 3 aspects:   * Ground Robots * Ariel Robots * Home Robots   AV companies invest heavily in capturing image, video, and LiDAR data.  Spent a lot of time being experts at training algorithms (providing the high-quality data to label, analyze, annotate)  It’s about getting the right algorithms into the autonomous vehicles, technology, etc.   * They have become more and more complex as technology involved. * You are aggregating multiple technologies and using that multi-sensor fusion to train algorithms.   As the 1st autonomous vehicles are going into “launch mode”, clients start to look at mapping solutions.   * Mapops are becoming a big share of their market. * Scaled, high-quality, increasingly complex/nuanced.   You build maps to fit your complex needs and fit them to the different situations found in different places.   * How do you dynamically respond to changes? * Ex: a sports event, etc.   iMerit are the experts bringing the products into “launch mode” by being the experts in the edge cases.   * Proactively address edge cases through labelops and mapops.   IMerit also looks at things like driver distraction and the flickering of eyelashes using a camera to deduce if there is driver distraction, movement of the face, speech detects, and natural language processing.  Companies provide data sets (camera, LiDAR, radar, etc) for labelling (ex: this is a stop sign, this is a dog, etc)  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  Different stages in a product’s life cycle require different data.  The data provided is a multi-sensor fusion (Radar, LiDAR, camera, etc.) that makes it accurate but also complex.  You start to want to have domain expertise.  The vehicle needs to be able to read road conditions to navigate the proper/best path.   * This can be complicated (street sign vs worker holding street sign, a stop sing swinging off a moving school bus, etc). * You can have false positive readings of the environment.   A lot of the work iMerit does is reflections (ex: people are walking, and you pick up the reflections)   * On Halloween, people are walking in costumes (is something a dog or a person dressed as a dog?)   Making these subjective assessments and looking into edge cases is important to be able to label and make mapops around.  Missing an object (especially close to the AV) could lead to an accident/be fatal to the AV.  iMerit is getting more into predictive tagging (looking at trends and using those to make predictions, especially in video object tracking).  iMerit needs to solve these edge cases to provide safety for the AV by correctly detecting and labelling these objects.  Incorrectly classifying information could also lead to issues (ex: collisions, misguidance).  iMerit investigates things such as cross mapping information, having real-time data feedback, analyzing traffic, looking at complex road transitions (ex: freeways), etc.  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  Edge cases have increased in complexity over time (ex: person wearing a costume, holding a cone, etc.)  A lot of edge cases previously seen as difficult/something that needed to be labelled (ex: a door opening) are now seen as basic work and may even be automated to some degree. Now the focus is on predictive and movement (video object tracking).  You need to pay attention to reflections (seen in a lot of edge cases).   * Ex: difference between smoke, exhaust, wispy clouds? * You need to detect the differences between things like these (seeing smoke is a lot worse than just seeing exhaust). This could be the difference between taking a proactive action and just ignoring it.   This is where the technology and experts become important (analyzing/interpreting edge cases).  iMerit used to classify objects (this is a cat, this is a dog, this is a human, etc).  They cannot think transactionally anymore (no longer just libraries that exist but is much more dynamic).   * Ex: what happens with policy changes and instructions. * These changes can happen 3-4 times a week. * Classifications can be so nuanced that iMerit sometimes need to capture the complexities and nuances. * Consistency is important (analyzing nuances).   iMerit may go beyond just the technological side of this.  There may be many conversations on just one image on how they should label it (capture the nuances).  Capture the edge cases in an edge case module and when it happens enough times you test it the next time it happens (if it happens enough times, it becomes a policy).  Very nuanced, complex, judgmental (aggregating images/information from different technologies together into a label).  It has become advanced to the point where it has become like a joint project between the client and iMerit.  It is not a library because the algorithms and technologies in the cars are different from one large AV client to another. They may go into multiple cars, but the technology is different. The data science is different.  The relationship between the data (client) to the labelops, the mappers, the mapops, etc become more personalized.  The libraries (policies and instructions) are different for each workflow.  Very interactive and dynamic.   * Will only get more dynamic as they get into launch cities (deployment).   5 steps:   * Labelops * Mapops (building of the maps) * Audit * Post-analysis * Validation (validating that everything comes together and works)   ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  AVs are in the first steps of the “last mile” before mass deployment.  They should not think about it as the “last mile” (just the beginning of launches).  They are essentially in pre-production.  A major part to being successful is being able to navigate in the physical environment.   * Edge cases probability * Different vehicles, different cities * Real-time data feedback, traffic analysis, complex road transitions * Reading road conditions   Highly sophisticated set of algorithms with many sensors.  How do we get cities to assess getting and sharing data?   * Mapops should be sharable at their core (metrics, etc.) * Sharing may become important to increase safety, accessibility, and efficiency in cities by a factor by multiple (having proactive access to the data that is changing).   ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  Once there are enough AVs on the road, a lot of focus will be on autonomous mobility increasing safety, accessibility, and efficiency in cities by a factor of multiples (the end focus of autonomous mobility).  What does that mean for what we need to do?  Important aspects:   * Sharing data between AV ecosystems (companies and local governments) * Human driver intervention (speech detects, natural language processing) * Policies on local/state levels. * Environmental improvements * Demographic insights * Safety protocols to deploy at scale. * Creating highly efficient cities (dynamically reacting to different factors). **Smart cities**. * Companies, cities, and governments coming together (making an ecosystem that flows seamlessly)   Future: Smart robots (AVs) being able to know your schedule and the landscape and be able to shuttle you from place to place (redefining autonomous mobility).  Some cities have really smart CIOs (important for the technology and AV companies to embrace that system).  Bringing different aspects together Is where the future is at.  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  Building a diverse workforce has been a focus for iMerit.  Having an inclusive workforce (diverse inclusive).  Inclusivity is what allows these technologies to be ubiquitous.  The autonomous mobility revolution is going to create lots of different kinds of workforces (government, public works, iMerit, etc). All kinds of jobs in different scenarios.  Having different kinds of inputs, voices, views, and biases (more representative) makes the technology better. | **Academic vocabulary…**  stalwarts  aggregate  transference  proactive  nuanced  expertise  subjective  assessments  analyzing  judgmental  dynamic  embrace  protocol  ubiquitous  Microcosm |
| **Technical terminology…**  AI  computer vision  just in time data  edge cases  autonomous technologies  autonomous mobility  natural language processing  speech to text  LiDAR  algorithms  semantic segmentation (semseg)  panoptic  multisensory fusion  labelops  mapops  data sets  labelling  AV  Smart cities |

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| **Headings** (after) | **Notes** (during) | **Academic vocabulary…** |
| **Technical terminology…**  launch mode  humans-in-the-loop  key point annotation  driver distraction  tracking errors  prediction tagging  panoptic  video object tracking  feed maps  live maps  real time data feedback  traffic pattern analysis  complex road transitions |

Outline of Episode

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| **Take notes** | **Time** | **Topics** |
| N | 0 – 5:50 | Radha’s background and career; creation of iMerit |
| Y | 5:50 – 12:12 | The problems iMerit works to solve; the data world of AVs |
| Y | 12:12 – 19:00 | Working with AV data sets and improving AV performance: mapping, real time data feedback, traffic pattern analysis, complex road transitions, etc. |
| Y | 19:00 – 30:08 | Edge cases and data libraries. Moving beyond labeling/classifying to predicting.  From edge cases to policies. From data libraries to policies.  5 steps of AV data: Label Ops, Map Ops, Audit, Post-analysis, Validation |
| Y | 30:08 – 37:33 | Remaining data challenges on way to Level 5 AVs:  Actually navigating the real world. Sharing data, assessments, metrics. |
| Y | 37:33 – 46:58 | Remaining non-data challenges for autonomous mobility:  Increase safety, accessibility, and efficiency. Sharing data. Human driver intervention. Navigating local, state, and federal regulations and policies. Environmental improvements. Safety protocol. “Smart cities.” Precision agriculture. Data ecosystem. |
| Y | 46:58 – 51:44 | Workforce needed for AI and autonomous mobility |
| N | 51:44 – END | Wrap-up |

Unanswered Questions / Research Questions

* Identify unanswered questions and/or generate research questions based on this podcast. 5-10 questions total.

1. What are the next steps in AV development? What aspects will be focused on? Will some aspects be focused on more than others?
2. How do you create “smart cities”/a seamless ecosystem between companies, policies, and the government?
3. How do companies like iMerit label different objects?
4. How do companies like iMerit handle edge cases? Are some scenarios valued more than others?
5. What still needs to happen for AVs to achieve everyday use?

Preliminary Research

* This conversation touches on a number of terms and topics related to the autonomous vehicle (or autonomous mobility) field. Your task is to choose one to research and learn a little about. Some of these are tricky to search because the terms (or parts of them) are used in other contexts. Because of this, you might want to add the term AV or autonomous vehicle or self-driving cars to your search.
* Topics to choose from:
  1. Autonomous vehicle mapping; HD maps (high-definition maps)
  2. Computer vision
  3. Edge cases
  4. Natural language processing
  5. Speech to text
  6. LiDAR
  7. Semantic (image) segmentation; semantic image segmentation; “semseg”
  8. Multisensor fusion; multisensor data fusion
  9. Humans-in-the-loop
  10. (Video) object tracking
  11. Something else you noticed during the podcast
* Below, you should…

1. identify your topic
2. list your search terms
3. provide links to 3 quality sources that speak to this question
4. write a brief (3-5 sentences) summary of what you learned from ONE of those sources.

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| **Research Topic:** | Lidar |

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| **Search Terms:** | **Links to 3 sources:** | **Info learned from ONE of those sources. 3-5 sentences.**  (Indicate the source by highlighting the source link) |
| Autonomous cars  AV  Self-driving  LiDAR | [An Overview of Lidar Imaging Systems for Autonomous Vehicles](https://www.mdpi.com/2076-3417/9/19/4093) | LiDAR (Light Detection and Ranging) works by counting the time between events in magnitudes carried out by light. From these time measurements, the speed of light is used to calculate distances and map objects. LiDAR will be at the core of autonomous vehicles, along with other data collection techniques such as radar and video cameras. Lidar-imaging for AVs require a combination of long-range high-spatial resolution, real-time performance, and tolerance to the sun in the daytime. Having a LiDAR rotate on a wheel allows for greater data collection, though large-scale automotive applications require even more performance (such as having the LiDAR come in a small packaged sensor that won’t protrude from/on the vehicle). |
| [[2004.08467] Lidar for Autonomous Driving: The principles, challenges, and trends for automotive lidar and perception systems](https://arxiv.org/abs/2004.08467) |
| [Towards autonomous driving: Principles of LiDAR and sensing systems | AIP Conference Proceedings | AIP Publishing](https://pubs.aip.org/aip/acp/article-abstract/3144/1/030023/3299447/Towards-autonomous-driving-Principles-of-LiDAR-and?redirectedFrom=fulltext) |