

Visualizing the evolution of technology with virtual reality

Government University Industry Research Roundtable

June, 2017

Fung Institute Patent Lab, UC Berkeley

Ankit Dutta, Lee Fleming, Tinashe Giyavha, Scott Johnson, Mohammad Keshavarzi, Guan-Cheng Li

The cumulative support of the NSF over the years has made this possible (1536022, 1360228, 1064182, 0965259, 199704).

Thank you SciSIP!

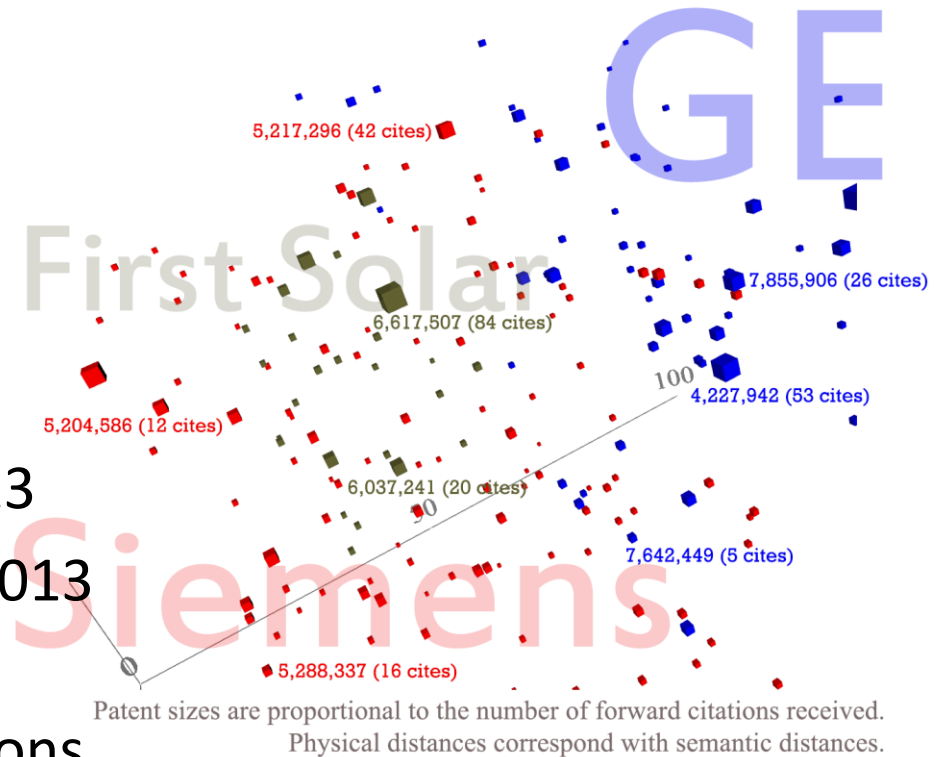
Work is copyrighted and patent pending.

Outline

- The idea – use VR to explore technology space
- Two questions before you enter virtual reality
- Movie snippets
- Could visualize impact of government R&D – what about commercial applications?
 - prior art identification
 - strategic analysis
 - once you visualize history, can you predict?
 - Cost and hassle need to drop for adoption

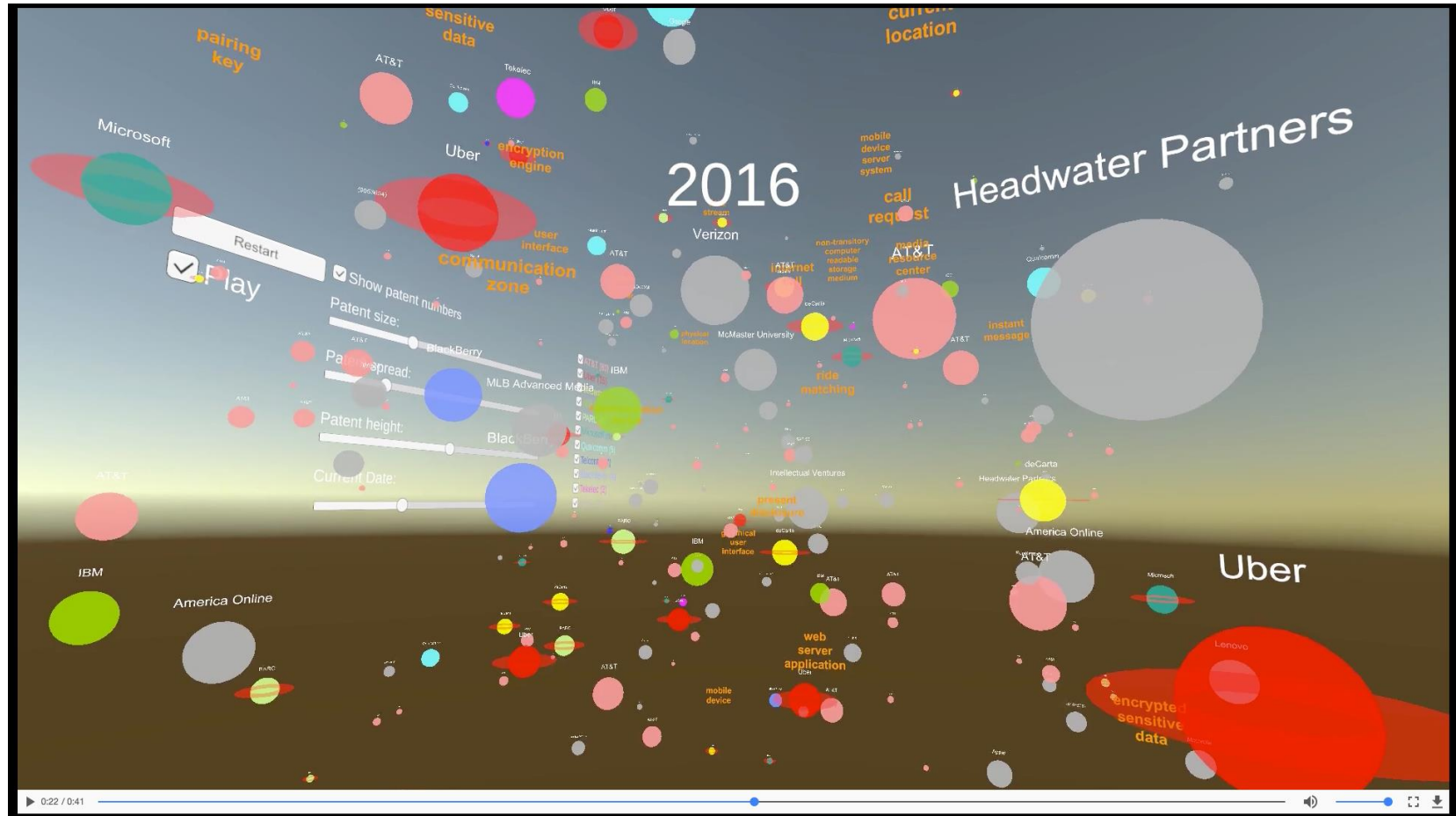
Evolution of the idea of technology space

- March 1991
- Stuart and Podolny 1996
- Rosenkopf and Nerkar 2001
- Fleming 2001
- Ullman and Rajarman 2011
- Nanda, Young, & Fleming 2013
- Our first: GE, Siemens viz in 2013 (by Guan Cheng Li)
- Already thinking in 3 dimensions
 - When virtual reality arrived
 - All demos < 1 week old



Orbs are patents, colored by firm, sized by citations

(public url: http://fung-storage.coe.berkeley.edu/vr_movies/)



Two important questions

- Orbs are patents in technology space, but
 - 1) What patents make it into the space?
 - 2) What does the distance mean?
- Only beginning to answer these questions
 - Working with a European car company
 - Actively seeking other partners

What patents make it in?

- Will demo 3 ways to slice space:
 - 1) Firm (assigned at invention or acquired)
 - Uber invented and patented
 - Plus matched sample
 - 2) Technology (classes or words)
 - Build dictionary with IEEE and textbook
 - Plan hierarchical clustering – example is top n grams
 - 3) Seed w/ expert curated words (easiest to interpret)
 - Citation
 - Geography
 - Social

What does distance mean?

- How do you reduce thousands of concepts or words (and other features) to 3 dimensions?
- So far just PCA but exploring other approaches
- Hard but exceptionally important question...

What do words (“signposts”) mean?

- “Center of Mass” of lexical feature
- Think of the words as landmarks or street signs in a neighborhood – gives an idea where you sit in “technology space.”
- Still debugging this – with thousands of words, sometimes seeing strange spatial correlations
 - Ideally, patent focused on nearby topics

What does node size mean?

- Currently, recent cumulative citations
 - Nodes that shrink no getting cited
- Variety of possibilities (all potentially dynamic):
 - Financial value (Kogan et al. 2017)
 - Number of blocking actions
 - How “strong” is this patent at stopping future patents?
 - Size of inventing team
 - Recent sale
 - Litigations

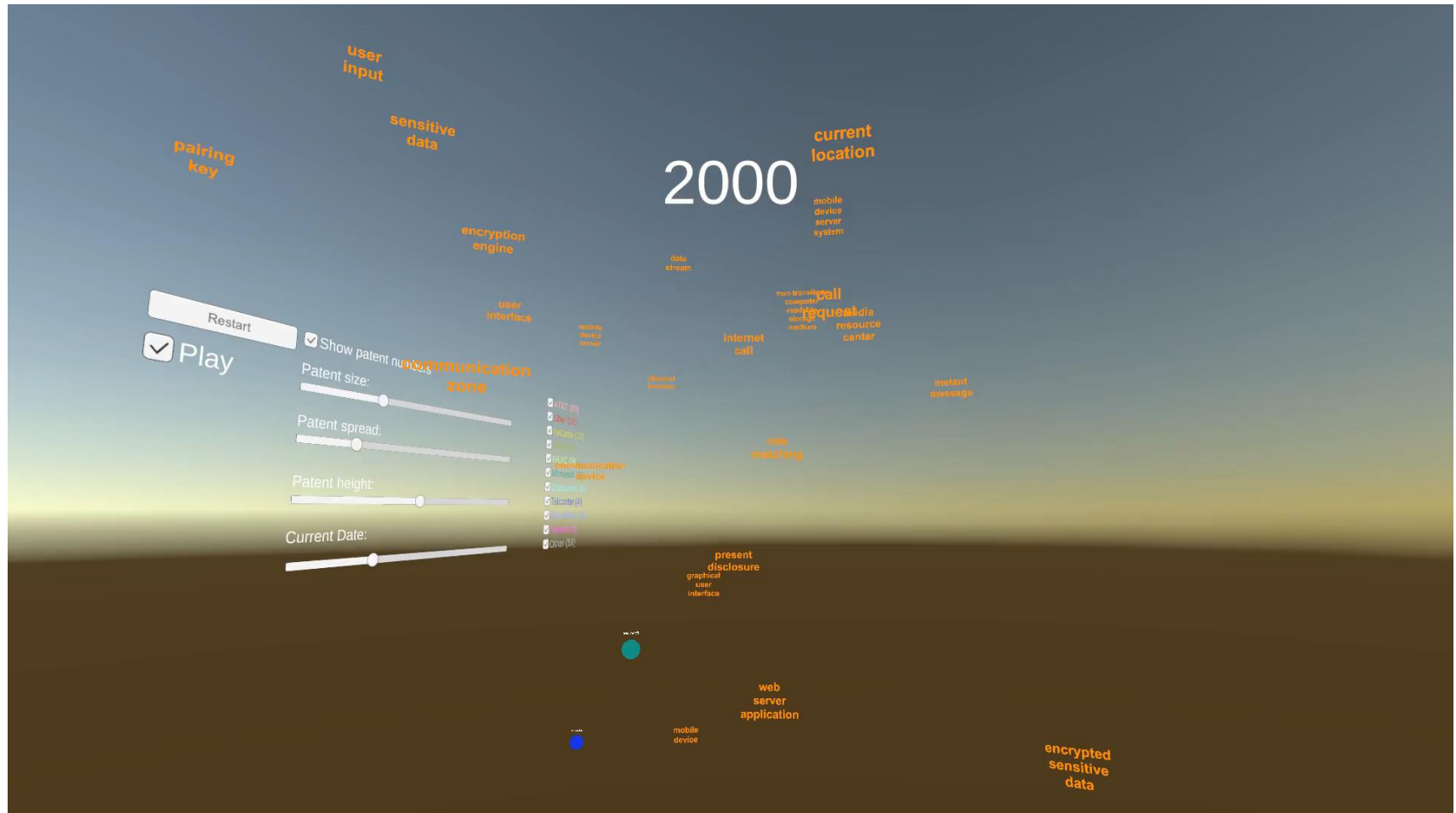
The evolution of Uber's portfolio (1)

- Seed: all Uber patents granted by 2016
 - 113 Uber (15 invented, 98 bought) + 113 controls
 - Controls identified by similar doc2vec n-grams
 - From abstract and claims
- Red and “Rings of Saturn” indicate Uber
 - Rings around non-red indicate bought patents
- 2001-2016
 - AT&T invents early, Uber won't appear until late

Uber entered space previously dominated by AT&T and deCarta (and bought latter)

- Sampling of lexical neighborhood:
 - Call request
 - Current location
 - Mobile device server system
- Sampling of neighbors:
 - AT&T
 - deCarta: mapping company bought by Uber
 - PARC
 - Microsoft

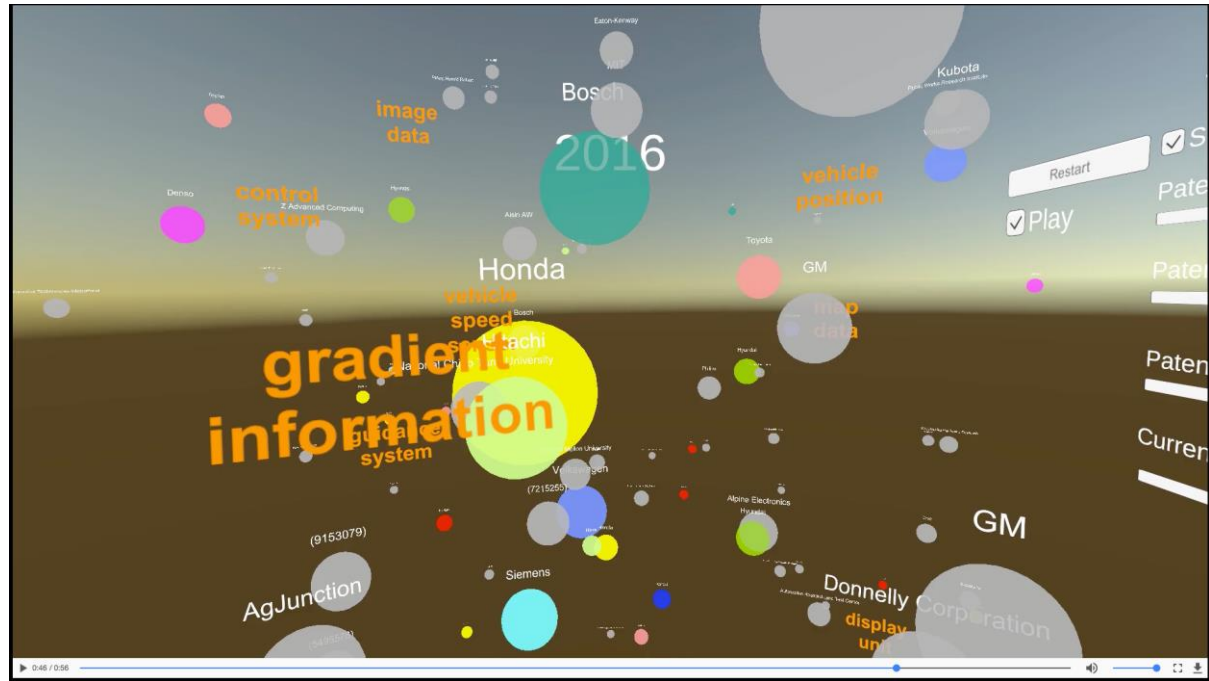
Uber snippet



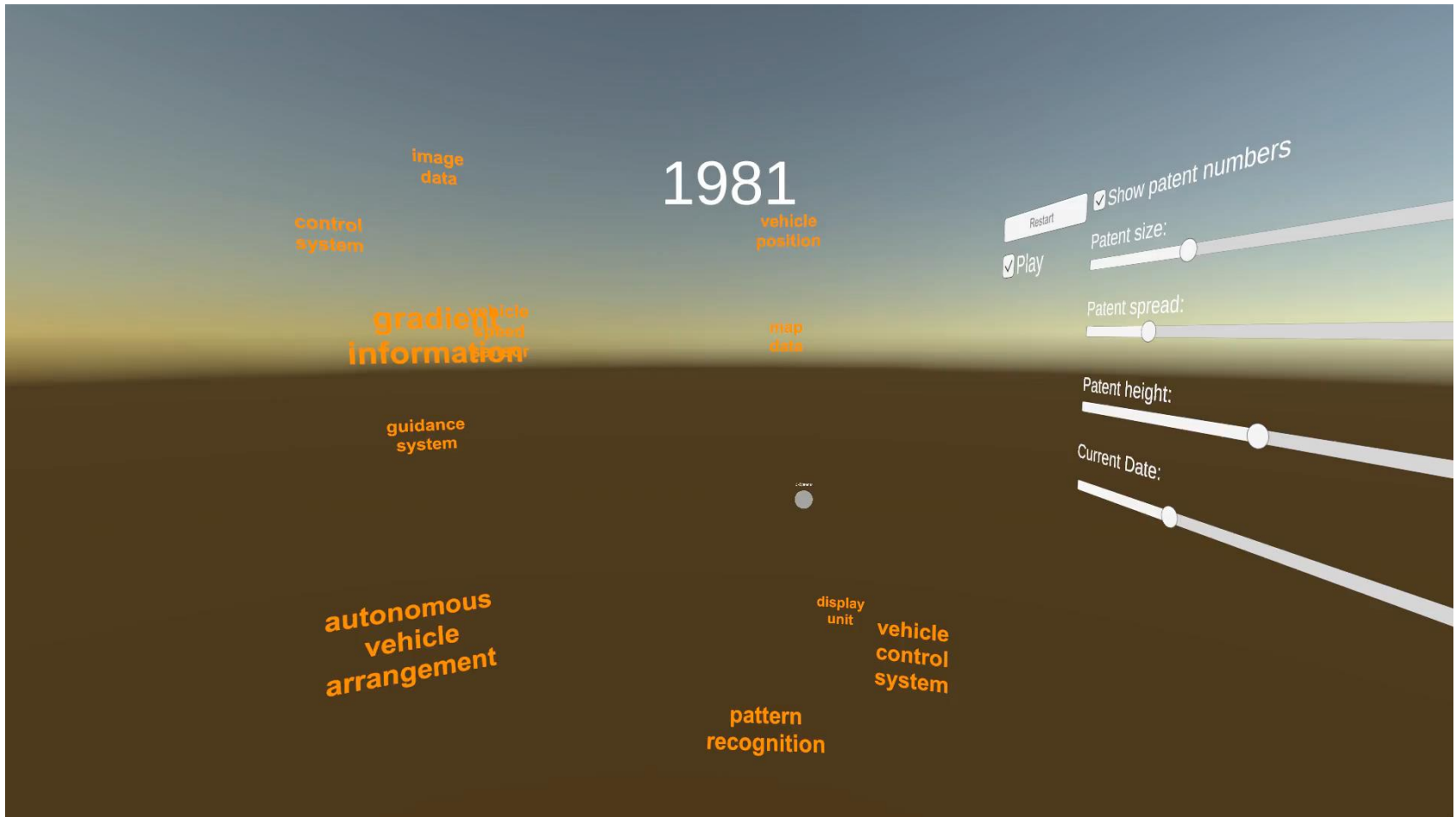
The evolution of autonomous vehicles with automated definition of space (2)

- Tokenized textbook and pertinent IEEE articles
 - *Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation*, by Cheng and Hong
 - Intelligent Vehicles Symposium, Robotics and Automation Proceedings, IEEE International Conference on Robotics and Automation, Proceedings ICRA, IEEE International Conference on Intelligent Vehicles Symposium, Proceedings of the IEEE Transactions on Robotics and Automation
- Looked for best lexical matches in patents
 - This pulled up historic patents, not recent
 - From abstract and claims
- Very diverse neighborhood
- See strong Asian presence
 - Honda has big yellow patent towards end

Automated identification of autonomous vehicle snippet (2)



- http://fung-storage.coe.berkeley.edu/vr_movies/vr_clip_3_autonomous.mp4



The evolution of autonomous vehicles with curated definition of space (3)

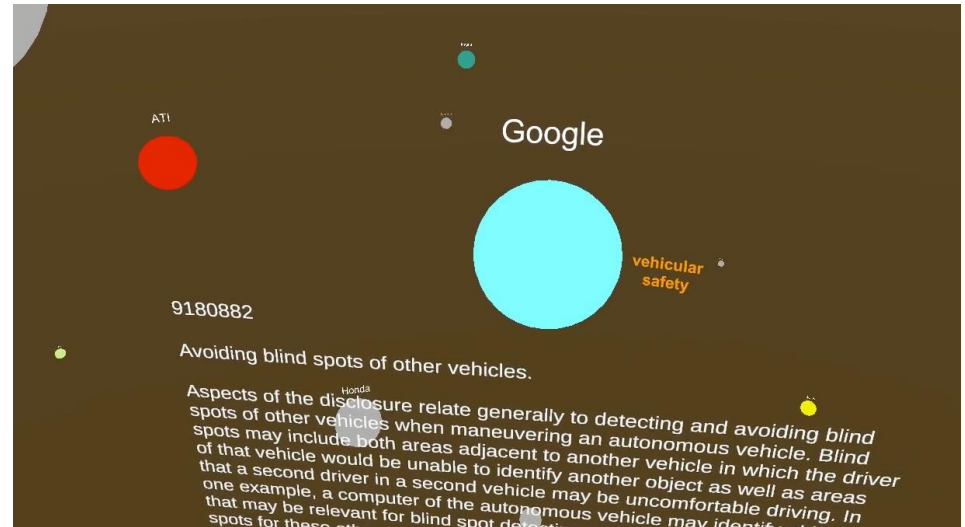
- Started from curated list of technologies
 - IP Watchdog:
 - <http://www.ipwatchdog.com/2016/04/07/autonomous-cars-patents-perspectives/id=68045/>
- Looked for lexical matches in patents
 - This pulled up historic patents, not recent
 - From abstract, claims, and *descriptions*
- 700+ patents – you are quickly overwhelmed
- However, signposts make more sense

Curated autonomous vehicle snippet (3)

- Pull down info
- Google blue
- GM orange

- http://fung-storage.coe.berkeley.edu/vr_movies/vr_clip_11_autonomous_2_Overview.mp4

- See more GM than Google
 - Bias towards history?
 - and possibly disclosure, rather than patenting?



1992

Future bells and whistles

- Papers placed into space just like a patent
 - How would you visualize commercial space?
- Citation overlay between patents, and papers
- Social networks overlay
- Click for full text, images, inventors, etc.
- Distance measurement
- Nodes as inventors?

Future research

- Ease of practitioner use...imagine
 - downloading the text of an application and its space – and potential prior art - comes up
 - specifying a granted patent and seeing potentially invalidating prior art
- Visualizing the impact of government R&D
 - Can tell the history of a field
- Prediction
 - Simple model to start, PCA gives 3 independent axes, so run three models
 - Spatial prediction active area of research
 - Lots of data to train on...

Captain Picard never had it this good!

