

Computer Vision

Towards a Simple Brute-Force Utility?

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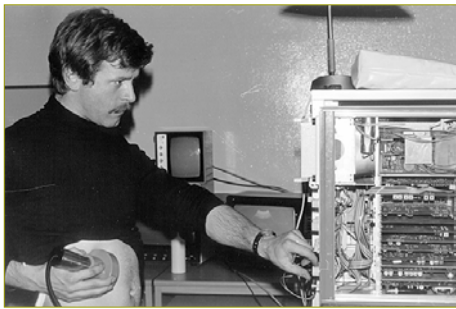
Early contacts ...



Kretztechnik
ca. 1980

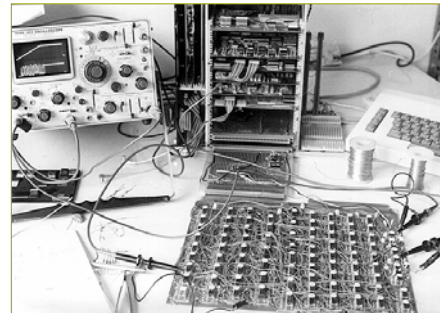
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ultrasound imaging ...



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much hardware, little software ...



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University of Utah (CS Dept., 1985)



- Graphics???
- Evans & Sutherland
- Internet!

- VLSI-Processing
- 2D Motion

- Bir Bhanu, Tom Henderson



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Honeywell Systems and Research Ctr.

Minneapolis (1986)

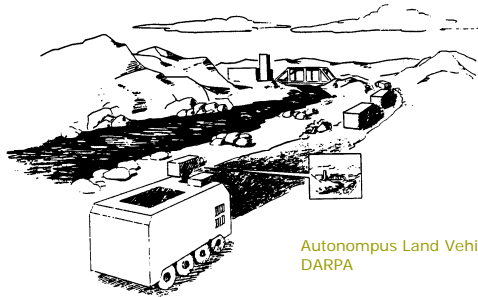


Symbolics 3670



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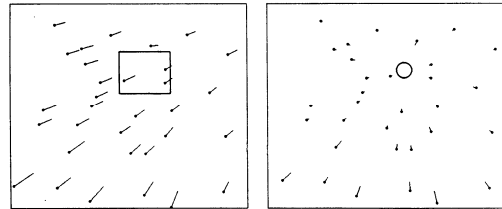
Driving the ALV ...



Autonomus Land Vehicle (ALV)
DARPA

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Motion flow fields



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Manual feature tracking ...

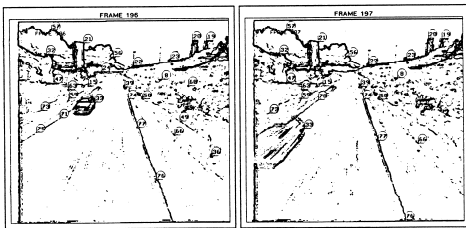


Figure 3.34(d): Frames 194-197 of the original image sequence after edge detection and manual point tracing.

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Computing ego-motion

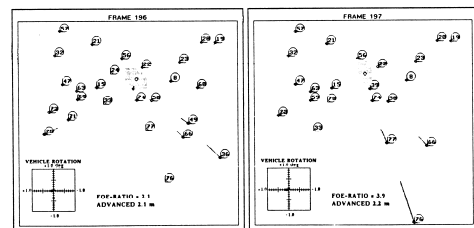


Figure 3.35(d): Displacement vectors and estimates of vehicle motion for frames 194-197 shown in Figure 3.34(d).

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Rules and Inference...

- (defrule FIRST-ENTITY-MOVES
(MOVEMENT-BETWEEN ?X ?Y)
(STATIONARY ?Y)
=>
(assert (MOBILE ?X)))

- (defrule SECOND-ENTITY-MOVES
(MOVEMENT-BETWEEN ?X ?Y)
(STATIONARY ?X)
=>
(assert (MOBILE ?Y)) .

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Multiple hypotheses

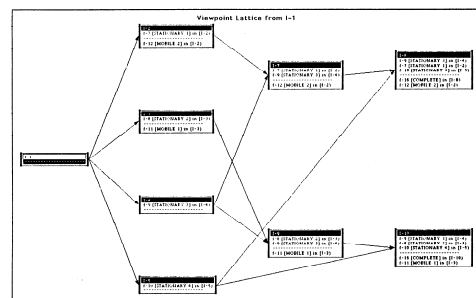
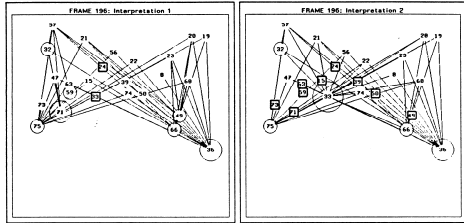


Figure 4.6 : Two different scene interpretations I-8 and I-10, which have been created by automatic merging of viewpoints. Notice that no merging between descendants of I-2 and I-3 can occur, because these viewpoints represent conflicting interpretations.

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Consistent worlds ...



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Primitive motion simulation

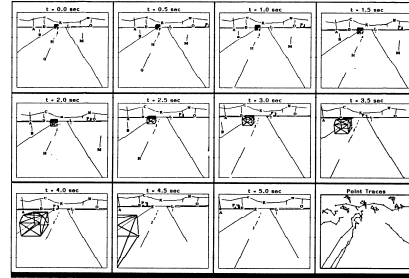


Figure 5.1: Synthetic image sequence seen from the moving ALV. The scene contains two moving objects, a van (marked F) which is approaching the ALV on the same road, and another vehicle (marked P) which is crossing the path of the ALV in the background from right to left. The traces of the marked points are shown in the lower right-hand corner.

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Modeling ambiguity ...

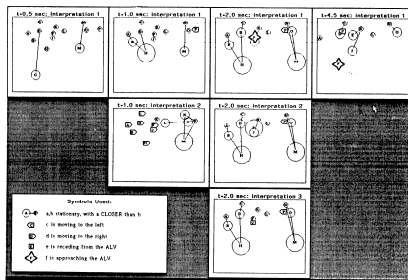
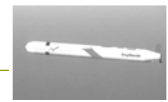


Figure 5.2: Development of the QSM. For four points in time (0.5, 1.0, 2.0 and 4.5 seconds) the state of the QSM is displayed by the set of complete interpretations that existed at these moments. Concurrent interpretations are stacked vertically without marking.

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In Retrospect ...



- "Strategic" projects
 - strong competition for money
 - vague specifications, assumptions, benchmarks ...
 - unrealistic expectations
 - very little test data (imagery, ground truth)
 - highly creative branding ("smart", "brilliant", ...)
- Deficient technology
 - data capture (video!)
 - processing power
- Brittleness everywhere
 - Ad hoc techniques
 - poor demos, inflated and unrelated results

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What has changed since?

- Remarkable progress in last decade
- Success in specific applications
- Major progress in
 - 3D reconstruction
 - object detection/recognition
- Much improved hardware
- Public Awareness



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What did not change ...

- The visionary's toolbox remains limited
 - histograms
 - voting
 - dimensionality reduction
 - random sampling
- Segmentation is still popular!
- Development of platforms did not advance
- High-level Vision?

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Media-Related Applications ...

- ▣ image database annotation/retrieval
- ▣ cinematography
- ▣ computer animation,
- ▣ level-creation for 3D games,
- ▣ virtual studios, mixed reality
- ▣ video analysis
- ▣ sports applications
- ▣ smile detection ☺
- ▣ Web (stitching, Google Earth, PhotoSynth etc.)
- ▣ + some bogus



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Statements I love ...

- ▣ "THE AI of this game was implemented ..."
- ▣ "I am doing THE Computer Vision of this project"
- ▣ "Oh, and it MUST work on a mobile phone ..."
(in real time)

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Is Computer Vision solved?



- ▣ Is CV more than inverted graphics?
- ▣ How "intelligent" should CV be?
- ▣ What about semantics?

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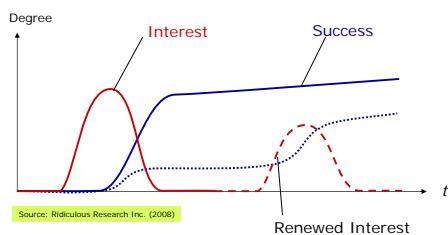
Research motives

- ▣ Reasons for investigating a problem
 - Everybody else does it
 - Nobody else does it
 - It is unsolved
 - It is solved but you don't know
 - You need to publish
 - ...
- ▣ Reasons for giving up on a problem
 - It is solved
 - It is too hard to solve
 - It is irrelevant (nobody cares)
 - You ran out of money
 - ...

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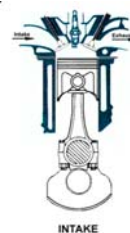
Evolution of problems

Once solved, interest in a particular problem naturally declines ...




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Is CV a typical engineering problem?



The basic idea is simple ...


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... but only needs refinement

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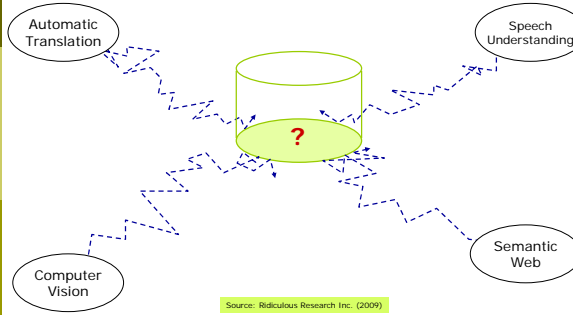
Does “Brute Force” Lead Anywhere?



- Computing power IS essential
 - makes costly processes eventually feasible
 - not just a cheap excuse
 - von Neumann machines can do it
 - new technologies: GPUs, multi-core CPUs
- But ...
 - Software/platform development is neglected
 - Too much small-scale development
 - Environments needed for stable, continuous, asynchronous, distributed, reconfigurable, debugable, ... operation.

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Semantics – The Holy Grail?



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Trying to summarize

- Semantics is a completely open issue.
- Don't try to emulate biological systems.
- Standard technology is fine (and evolving)
- Large-scale/high-level frameworks deserve renewed attention
- Computer Science education is not enough

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Some final thoughts ...

- Interesting applications in Human-Computer Interaction (all forms of “assistance”)
- Learning
 - Too limited view of learning (classif. of feature vectors)?
 - Small training sets (single exemplars)!
 - Breakdown and restructuring of concepts
 - Store and use “irrelevant” data
- Simulators
 - Long-term training & testing on large data sets
 - Ground truth (almost) for free

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Thank you!
And hold on to your dreams!

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