



embedded  
**VISION**  
ALLIANCE

# Welcome to the Embedded Vision Summit!

Westford, Massachusetts—October 2, 2013

Jeff Bier, Founder, Embedded Vision Alliance / President, BDTI

“Computer vision is the science and technology of **machines that see**, where ‘see’ means that the machine is able to **extract information from an image** that is necessary to solve some task.”

- Adapted from [en.wikipedia.org/wiki/Computer\\_vision](http://en.wikipedia.org/wiki/Computer_vision)

Computer vision is distinct from other types of video and image processing: it involves **extracting meaning** from visual inputs.

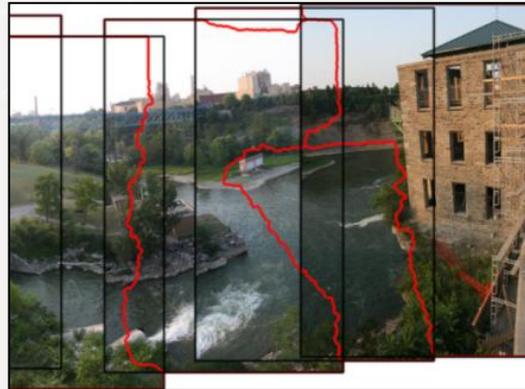
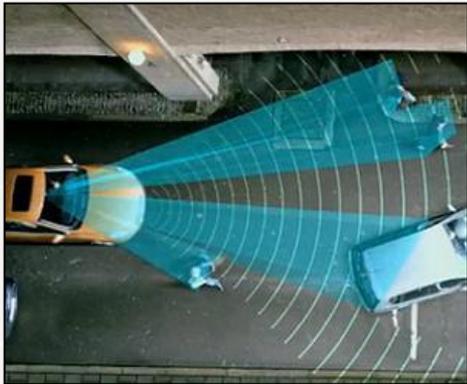
We use the term “embedded vision” to refer to the practical deployment of computer vision into a wide range of products and applications

- Industrial, automotive, medical, defense, retail, gaming, consumer electronics, security, education, ...
- In embedded systems, mobile devices, PCs and the cloud

# Welcome to the Era of *Embedded Vision*

Computer vision is not new...

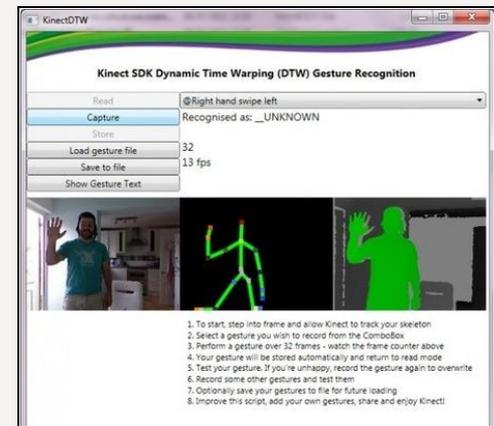
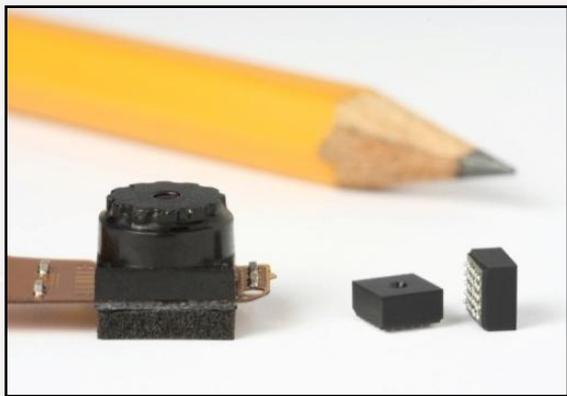
Its widespread deployment into our everyday lives is new



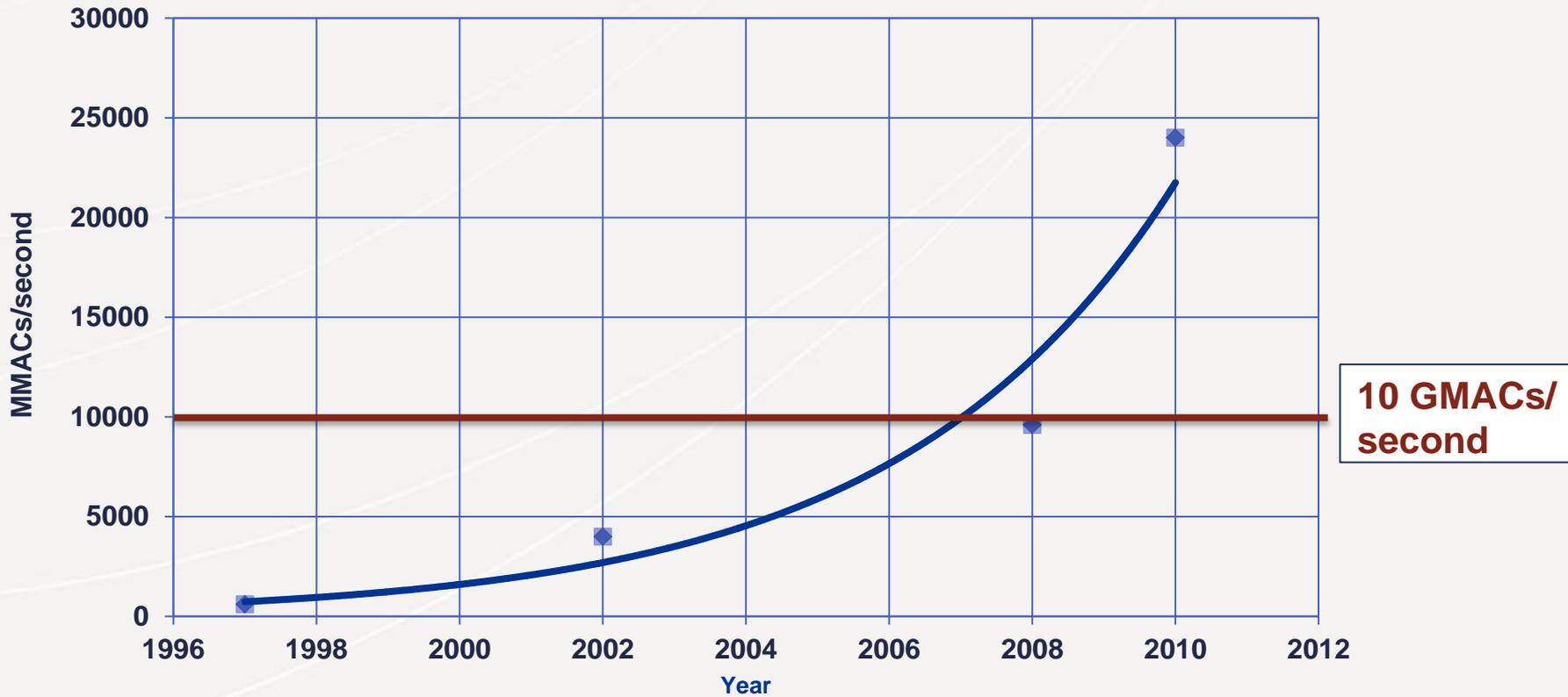
# Why is Embedded Vision Proliferating Now?

The proliferation of embedded vision is enabled by:

- Hardware: processors, sensors, etc.
- Software: Tools, algorithms, libraries, APIs



## DSP Performance: High-end, Single-core DSPs from TI



Source: BDTI Analysis

“Half of the human brain is devoted directly or indirectly to vision.”

- Paraphrased from Prof. Mriganka Sur, MIT

# What Makes Embedded Vision Hard?

- Infinitely varying inputs in many applications...
  - Uncontrolled conditions: lighting, orientation, motion, occlusion
- Leads to ambiguity...
- Compounded by lack of lifelong learning and integration of multiple senses...
- Leads to the need for complex, multi-layered algorithms to extract meaning from pixels
- Plus:
- Lack of analytical models means exhaustive experimentation is required
- Numerous algorithms and algorithm parameters to choose from



- Most vision applications involve high data rates and complex algorithms
- For vision to be widely deployed, it must be implemented in many designs that are constrained in cost, size, and power consumption
- These constraints, combined with high performance and bandwidth demands, creating challenging design problems
- Modern embedded CPUs often have the muscle, but are often too expensive or power-hungry
- Many vision applications require parallel or specialized hardware
  - Algorithms are diverse and dynamic, so fixed-function compute engines are less attractive
  - E.g., DSP, GPU or other co-processor
- It's a whole-system problem

- Many product creators are unaware that embedded vision is becoming feasible for their products
- Most product creators have no experience incorporating vision into products
- It's hard to find resources for learning the practical aspects of vision
- Applications are diverse
- Enabling technologies (e.g., sensors, processors) are diverse and changing rapidly

The Embedded Vision Alliance ([www.Embedded-Vision.com](http://www.Embedded-Vision.com)) is a partnership of 35 leading embedded vision technology and services suppliers

Mission: Inspire and empower product creators (including mobile app developers) to incorporate visual intelligence into their products

The Embedded Vision Alliance is the “go-to” resource where thousands of engineers turn when creating new vision-based products

The Alliance provides high-quality technical educational resources for engineers, free or at low cost

- The Embedded Vision Academy offers in-depth tutorial articles, video “chalk talks,” code examples, tools and discussion forums
- The Embedded Vision Insights newsletter delivers news, Alliance updates and new resources



# Embedded Vision Alliance Members



# Vision Technology and Service Suppliers: Join the Alliance

- Alliance Member companies position themselves as leaders in front of thousands of product creators who visit the Alliance web site each month
- Multiple Embedded Vision Summit conferences each year introduce Member companies and their products prospective customers
- Our Member companies meet quarterly to develop business partnerships and gain insights into embedded vision markets and technology trends
- We secure frequent press coverage on embedded vision topics, gaining exposure for our members as thought leaders
- Companies interested in joining the Alliance may contact us via [membership@embedded-vision.com](mailto:membership@embedded-vision.com)



- **8:00 AM**      **Check In**
- **9:00 AM**      **Welcome Remarks**  
Jeff Bier, Founder, Embedded Vision Alliance, and  
President, BDTI
- **9:30 AM**      **Keynote Presentation: Embedding Computer Vision in  
Everyday Life**  
Mario Munich, Vice President of Advanced Development,  
iRobot
- **10:30 AM**      **Morning Break with Demos  
(Westford Ballroom, Upper Level)**

## Track 1: Fundamentals

### Session 1A: Vision Applications

- 11:00AM: *What Can You Do With Embedded Vision?*  
Jeff Bier, Embedded Vision Alliance
- 11:30AM: *Vision-Based Gesture User Interfaces*  
Francis MacDougall, Qualcomm
- 12:00PM: *Vision-Based Automotive Driver Assistance Systems: Challenges and Approaches*  
Paul Zoratti, Xilinx

**12:30 PM Lunch with Demos (Westford Ballroom, Upper Level)**

## Track 2: Advanced Topics

### Session 2A: Algorithm Development Techniques and Tools

- 11:00AM: *The DARPA Visual Media Reasoning Program*  
Mike Geertsen, DARPA
- 11:30AM: *Using Synthetic Image Generation to Reduce the Cost of Vision Algorithm Development*  
Clark Dorman, Next Century Corporation
- 12:00PM: *Tools for "Democratizing" Computer Vision*  
Jayan Eledath, SRI International

## Track 1: Fundamentals

### Session 1B: Object and Feature Detection

- 1:30PM: *Finding Objects Using Canny Edge Detection*  
Eric Gregori, BDTI
- 2:00PM: *Algorithms for Object Detection and Tracking*  
Tim Jones, MathWorks
- 2:30PM: *Feature Detection: How it Works, When to Use It, and a Sample Implementation*  
Marco Jacobs, videantis

3:00 PM Afternoon Break with Demos (Westford Ballroom, Upper Level)

## Track 2: Advanced Topics

### Session 2B: Algorithms and Implementations

- 1:30PM: *Embedded Lucas-Kanade Tracking: How it Works, How to Implement It, and How to Use It*  
Goksel Dedeoglu, Texas Instruments
- 2:00PM: *Porting Applications to High-Performance Imaging DSPs*  
Gary Brown, Cadence
- 2:30PM: *Designing a Multi-Core Architecture Tailored for Pedestrian Detection Algorithms*  
Tom Michiels, Synopsys

## Track 1: Fundamentals

### Session 1C: Implementing Vision Systems

- 3:30PM: ***Targeting Computer Vision Algorithms to Embedded Hardware***  
Mario Bergeron, Avnet
- 4:00PM: ***Using FPGAs to Accelerate 3D Vision Processing: A System Developer's View***  
Ken Lee, VanGogh Imaging
- 4:30PM: ***Using Heterogeneous Computing for Mobile and Embedded Vision***  
Rick Maule, Qualcomm
- 5:00PM: ***Embedded 3D Stereo Vision: How it Works, How to Implement It, and How to Use It***  
Goksel Dedeoglu, Texas Instruments

## Track 2: Advanced Topics

### Session 2C: Front-End Image Processing for Vision Applications

- 3:30PM: ***Better Image Understanding Through Better Sensor Understanding***  
Michael Tusch, Apical
- 4:00PM: ***Efficient Super-Resolution Algorithms and Implementation Techniques for Constrained Applications***  
Ilan Yona, CEVA
- 4:30PM: ***Efficiently Computing Disparity Maps for Low-Cost 3D Stereo Vision***  
Tom Wilson, CogniVue
- 5:00PM: ***Implementing Real-Time Hyperspectral Imaging***  
Kalyanramu Vemishetty, NI

## 5:30 - 7:30 PM: Reception with Demos

- Food and drink
- Over 25 demos of cool vision technology
- Interact with technology experts from Alliance Member companies
- Westford Ballroom, Upper Level



# Thanks to Our Sponsors



## "Embedding Computer Vision in Everyday Life"

Mario Munich, Ph.D.

Vice President of Advanced Development, iRobot

