PATENTS (INTELLECTUAL PROPERTY)

Presented to:
Industry Day July 8th, 2015
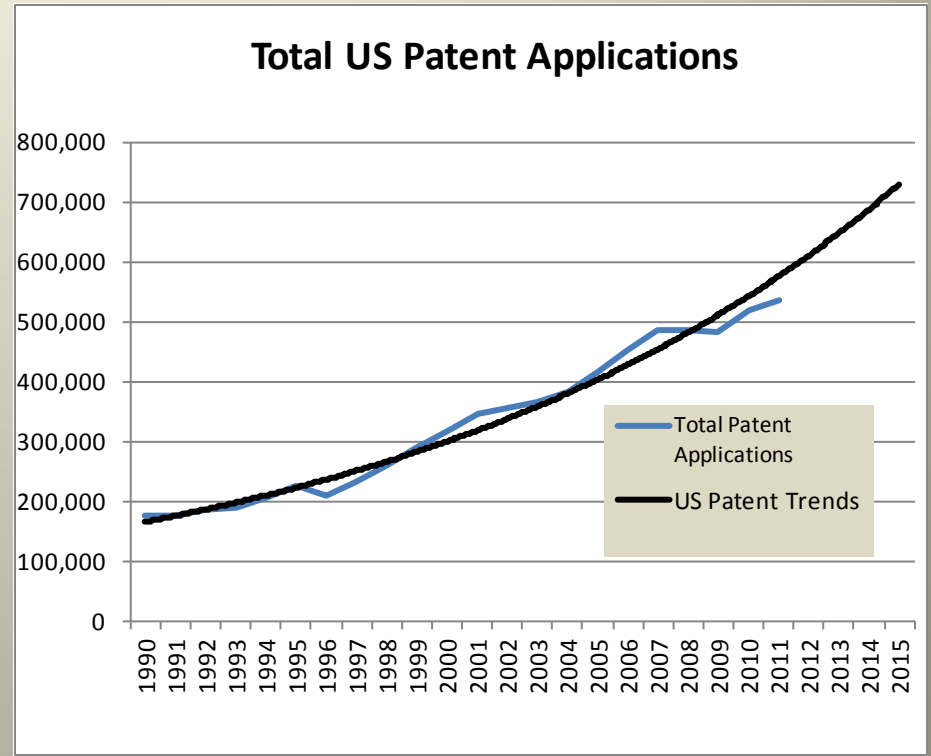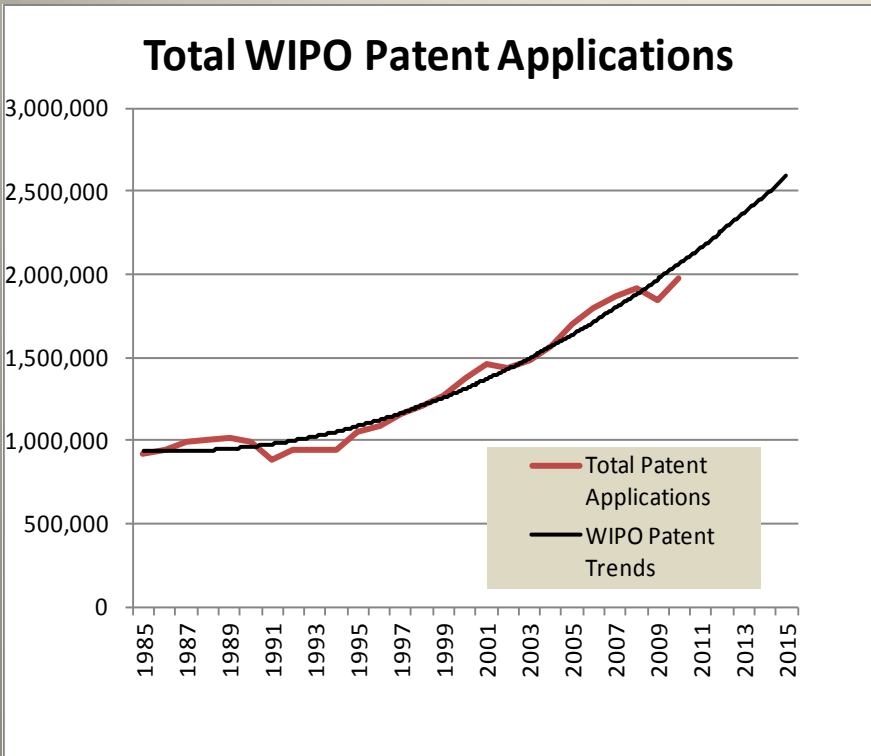
Presented by:
Charlene Haley, B.Sc., M.Sc., LL.B., J.D.

LEAD PATENT ATTORNEY

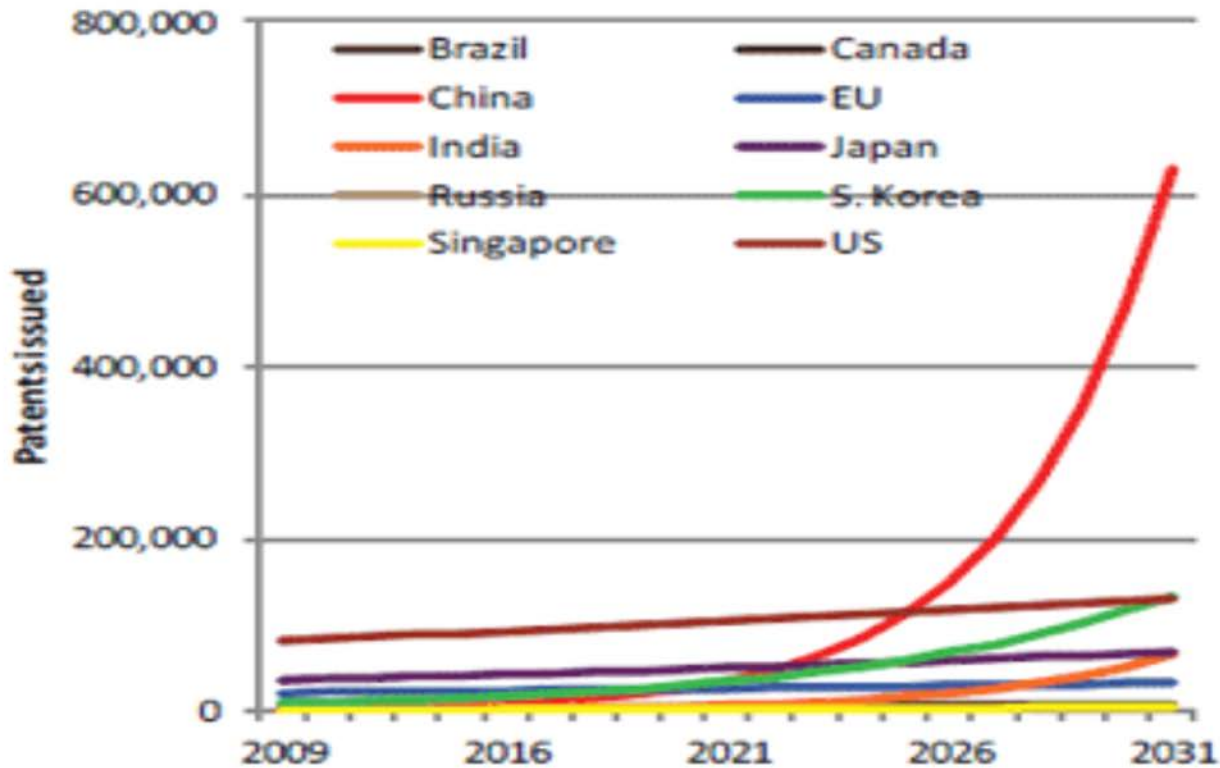NAVAIR

US and World Patent Application Trends

Total WIPO Patent Applications

Legend: Total Patent Applications, WIPO Patent Trends

Total US Patent Applications

Legend: Total Patent Applications, US Patent Trends

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"ISSUED PATENTS ON THE RISE"

Forecast USPTO Patents Issued (based on 1996-2009)

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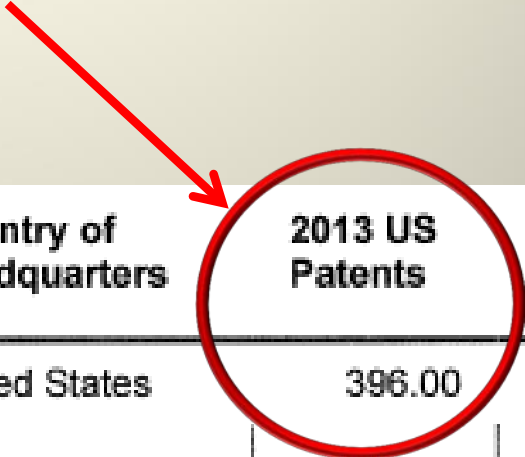
2011 IEEE Spectrum

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2014 IEEE Spectrum Patent Power Scorecard

Company/Organization	Country of Headquarters	2013 US Patents	Pipeline Growth Index	Pipeline Impact	% Self-Citations	Adjusted Pipeline Impact	Pipeline Generality	Pipeline Originality	Pipeline Power ▲
U.S. Navy	United States	396.00	1.11	0.63	0.20	0.63	0.83	1.08	246.58
Commissariat à L'Énergie Atomique et aux Énergies Alternatives	France	311.00	1.07	0.73	0.17	0.73	0.74	1.02	183.53
Centre National de la Recherche Scientifique	France	260.00	1.32	0.72	0.17	0.72	0.60	1.03	154.37
U.S. Department of Health and Human Services	United States	146.00	1.01	0.78	0.24	0.78	1.34	0.97	150.59
U.S. Army	United States	159.00	0.91	0.70	0.16	0.70	0.75	1.03	78.71
Agency for Science, Technology and Research	Singapore	74.00	0.94	0.80	0.03	0.80	1.17	1.10	72.07
National Aeronautics and Space Administration	United States	111.00	0.97	0.68	0.09	0.68	0.79	1.10	63.47
Japan Science and Technology Agency	Japan	77.00	0.92	1.25	0.03	1.25	0.60	1.21	63.35
Ministry of Economy, Trade and Industry	Japan	100.00	1.04	0.66	0.13	0.66	0.74	1.02	51.95
National Institute of Advanced Industrial Science and Technology (Japanese Ministry of Economy Trade and Industry)	Japan	100.00	1.04	0.66	0.13	0.66	0.74	1.02	51.95
U.S. Enviromental Protection Agency	United States	14.00	1.17	1.12	0.10	1.12	2.56	1.11	51.64
National Research Council Canada	Canada	37.00	1.48	0.69	0.24	0.69	0.91	1.11	38.53
U.S. Department of Energy	United States	47.00	1.21	0.83	0.07	0.83	0.72	1.02	34.35
U.S. Air Force	United States	58.00	1.04	0.65	0.17	0.65	0.68	1.09	29.06
U.S. Department of Agriculture	United States	60.00	1.03	0.34	0.19	0.34	0.65	1.29	17.40
Council of Scientific and Industrial Research	India	83.00	1.46	0.27	0.12	0.27	0.35	1.13	12.53
Institute of Nuclear Energy Research	Taiwan	53.00	1.26	0.36	0.20	0.36	0.33	1.03	8.23
U.S. Postal Service	United States	33.00	0.89	0.26	0.24	0.26	0.59	1.03	4.62
U.S. Department of Commerce	United States	13.00	1.00	0.37	0.20	0.37	0.44	1.14	2.40
Centre Nationale d'Études Spatiales	France	15.00	1.07	0.25	0.25	0.25	0.25	1.24	1.24

2014 IEEE Spectrum Patent Power Scorecard

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Commissariat à L'Énergie Atomique et aux Énergies Alternatives	France	311.00	1.07
Centre National de la Recherche Scientifique	France	260.00	1.32
U.S. Department of Health and Human Services	United States	146.00	1.01

*Top 300 Organizations Granted U.S. Patents in 2014 From Intellectual Property Owners Association (IPO): U.S. Navy 364 patents issued

2014 IEEE Spectrum Patent Power Scorecard

IEEE Score Card:
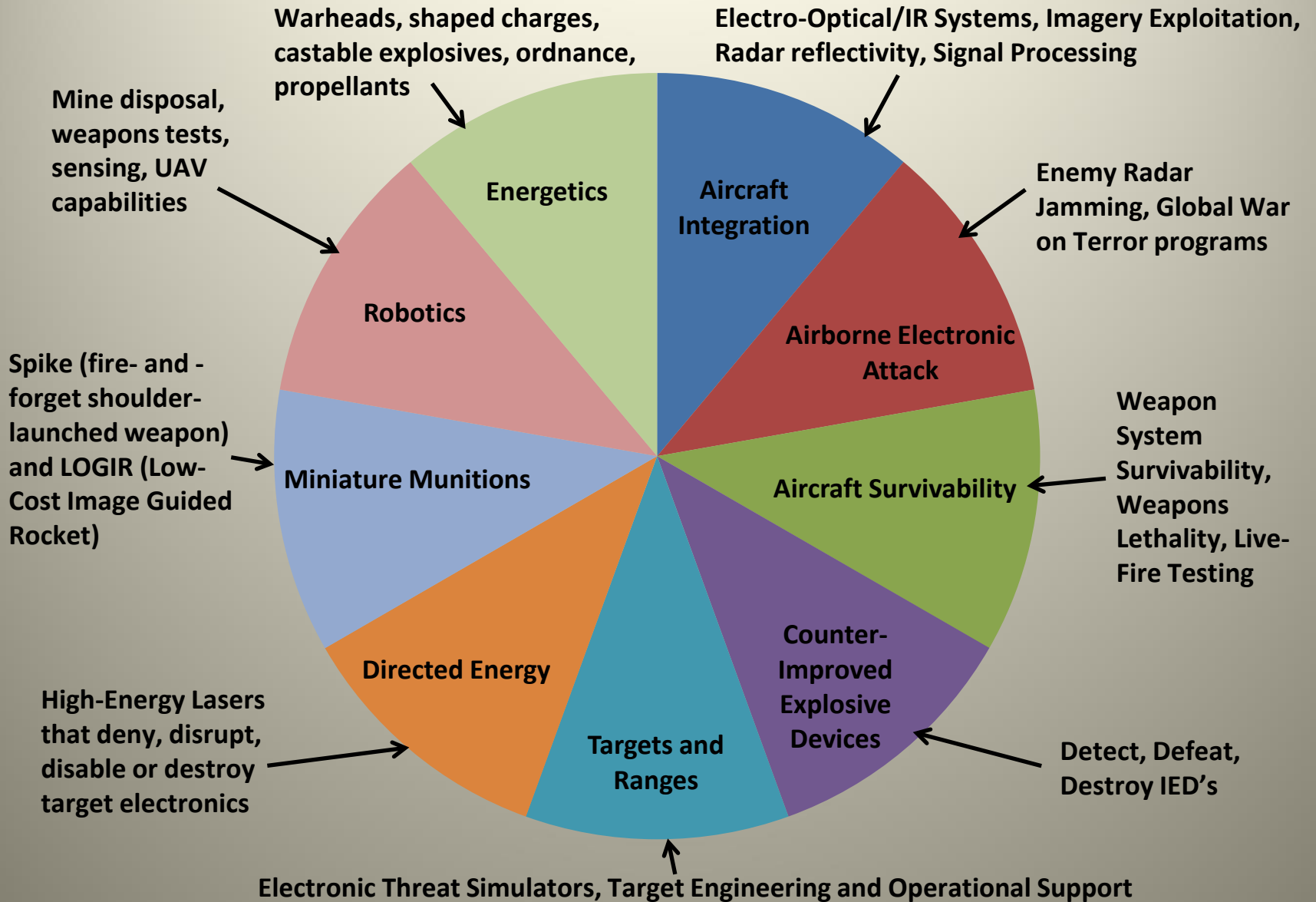
- **Navy was issued 396 patents for the 2013 calendar year**

NAWCWD:

- **46 issued patents for the 2013 calendar year**

- **NAWCWD makes up about 12% of the entire Navy issued patents!**

PATENTED TECHNOLOGIES

PATENTED TECHNOLOGIES AT NAWCWD

Warheads, shaped charges, castable explosives, ordnance, propellants

Electro-Optical/IR Systems, Imagery Exploitation, Radar reflectivity, Signal Processing

Mine disposal, weapons tests, sensing, UAV capabilities

Enemy Radar Jamming, Global War on Terror programs

Spike (fire- and -forget shoulder-launched weapon) and LOGIR (Low-Cost Image Guided Rocket)

Weapon System Survivability, Weapons Lethality, Live-Fire Testing

High-Energy Lasers that deny, disrupt, disable or destroy target electronics

Detect, Defeat, Destroy IED's

Electronic Threat Simulators, Target Engineering and Operational Support

Pie chart segments:
- Energetics
- Aircraft Integration
- Airborne Electronic Attack
- Aircraft Survivability
- Counter-Improved Explosive Devices
- Targets and Ranges
- Directed Energy
- Miniature Munitions
- Robotics

Top Patents with Commercial Potential!

1. LADAR Stream Formatting and Processing Method
    – US7561261 (Jeff Hilde)
2. Three Dimensional Shape Correlator
    – US8810779 (Jeff Hilde)
3. Alcohol to Jet Fuels/Renewable High-Density Tactical Fuels
    – US8574658, 9018314, 8993688, 8975463, 8969636, 8921614, 8785702, 8395007, 8350107, 8344196, 8242319, 8227651, 8987539 (Benjamin Harvey)
4. Poly(3,4-alkylene dioxythiophene) Based Capacitors Using Ionic Liquids as Supporting Electrolytes
    – US8962840, 8737038, 8680292, 8427812, 8183390, 7829660, 7608179, 7578859, 7456295, 6965509 (John Stenger-Smith)
5. Face Recognition Process
    – US8885893 (Katia Estabridis)

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Top Patents with Commercial Potential!

6. **Fumeless Latent Fingerprint Detection/Integrated plasmonic enhanced fluorescence for sensor application**
   – **US8574658 (Lee Cambrea)**
7. **Nanoplasmonic Cavities for Photovoltaic Applications**
   – **NC#102114, 102115 (Joe Roberts)**
8. **Small Object Detection Using Meaningful Features and Generalized Histograms**
   – **US8724850 (Grant Hanson)**
9. **System and Method for Time-Space-Position-Information (TSPI)**
   – **US9031725 (Raymond DiEsposti)**
10. **Perpendicular Drive Mechanism for Missile Control Actuation System**
    – **US8921749 (Aaron Scott)**
11. **Level Set Tree Detection**
    – **US8509546 (Arjuna Flenner)**
12. **Energy Harvesting Device Using Auxetic Materials**
    – **US9048761, 9030079 (Joe Roberts)**

LADAR Stream Formatting & Processing Method

SMART – Shape Matching Automatic Recognition Technology

LADAR Sensor

Shape Match Processing

Target

LADAR Data Stream

Range Data

Target Identified!

YES

Compare Range Data

High Score ?

NO

Modeled Sensor

LADAR Sensor Position & Pointing

3D Target Simulator

Select Next Target Simulator Parameters

Simulated LADAR Data

Range Data

Fast Loop Processing
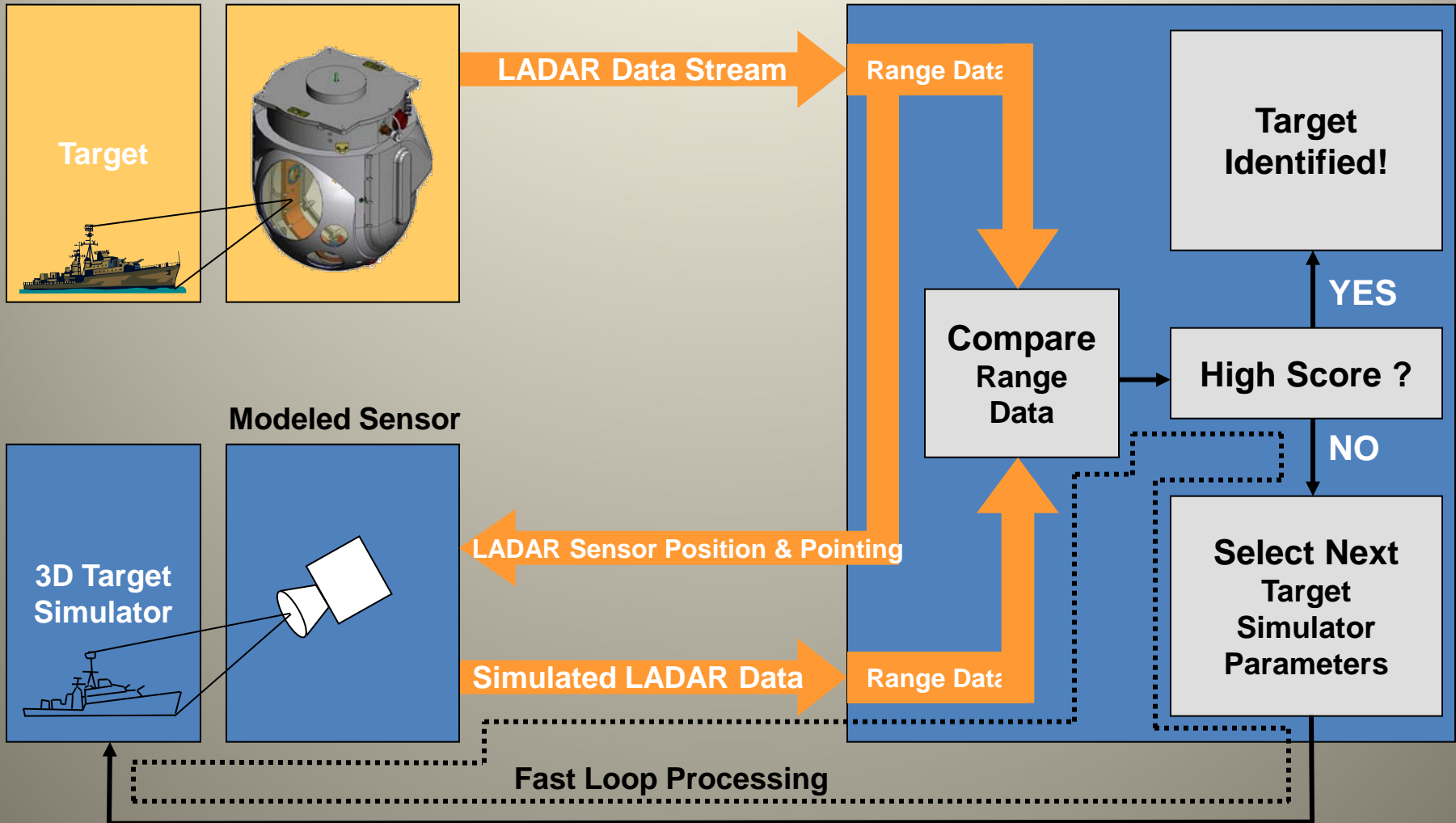
Three Dimensional Shape Correlator

SMART - Shape Matching Automatic Recognition Technology
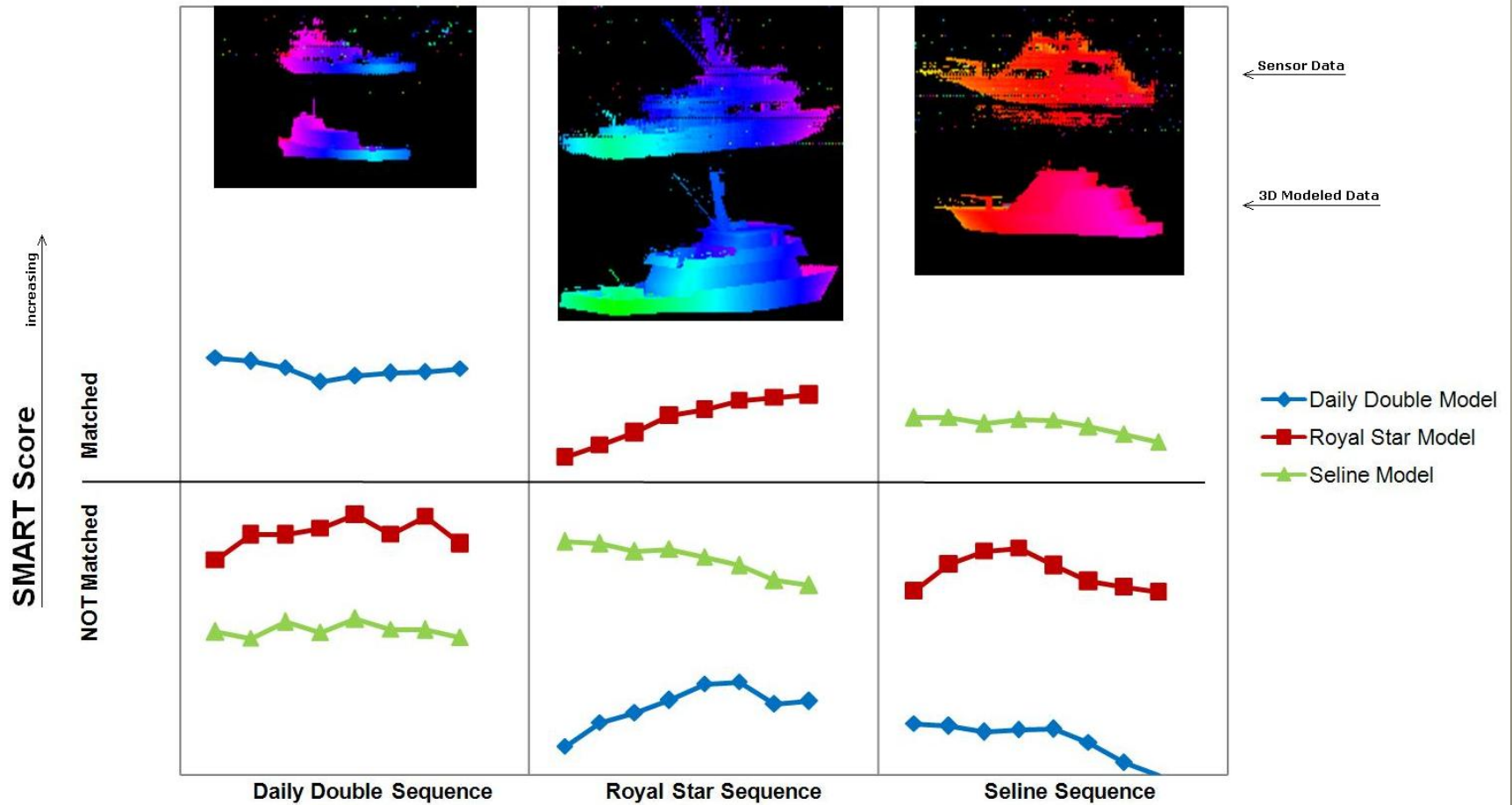
Alcohol to Jet Fuels
(Renewable High-Density Tactical Fuels)

Inventor: Dr. Benjamin G. Harvey

(Michael E. Wright, Heather A. Meylemans, and Roxanne L. Quintana on several of the patents)

We have developed a variety of renewable high density fuels that have applications for jet, diesel, missile, and UAV propulsion. These fuels can be produced in a sustainable fashion from waste biomass and have been designed to outperform both conventional renewable fuels as well as petroleum derived fuels.

Commercial / Alternative applications

- ✓ Jet/Diesel Fuel
- ✓ We have a variant that can be used as high octane gasoline—automobiles, av gas, etc.
- ✓ Motor oil
- ✓ Lubricants
- ✓ Resins
- ✓ Paint
- ✓ Coatings/Finishes
- ✓ Scents/Flavorings
- ✓ Cosmetics
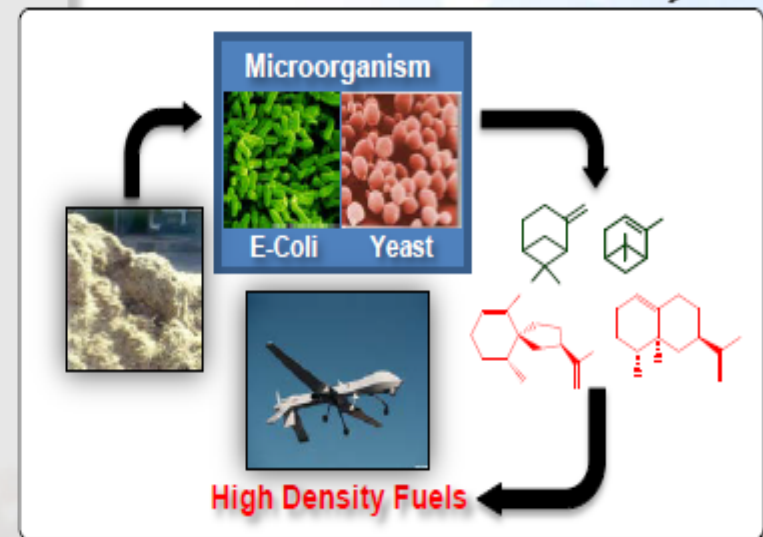
Microorganism

E-Coli   Yeast

High Density Fuels

Poly(3,4-alkylene dioxythiophene)-Based Capacitors Using Ionic Liquids as Supporting Electrolytes

- **High power energy storage**
  - **Higher power density than batteries (kW/kg)**
  - **Lower operating voltage than batteries (1-3V)**
  - **Shorter operating times than batteries (sec-min)**
  - **Higher energy density than traditional capacitors (~3Wh/kg)**
- **Applications**
  - **Military (short intense bursts of power)**
  - **Computer backup (less power, longer time)**
  - **Electric vehicle burst power (intermediate power and length)**

Poly(3,4-alkylene dioxythiophene)-Based Capacitors Using Ionic Liquids as Supporting Electrolytes

electrode substrate
p-doping polymer
electrolyte
separator paper
electrolyte
n-doping polymer
electrode substrate
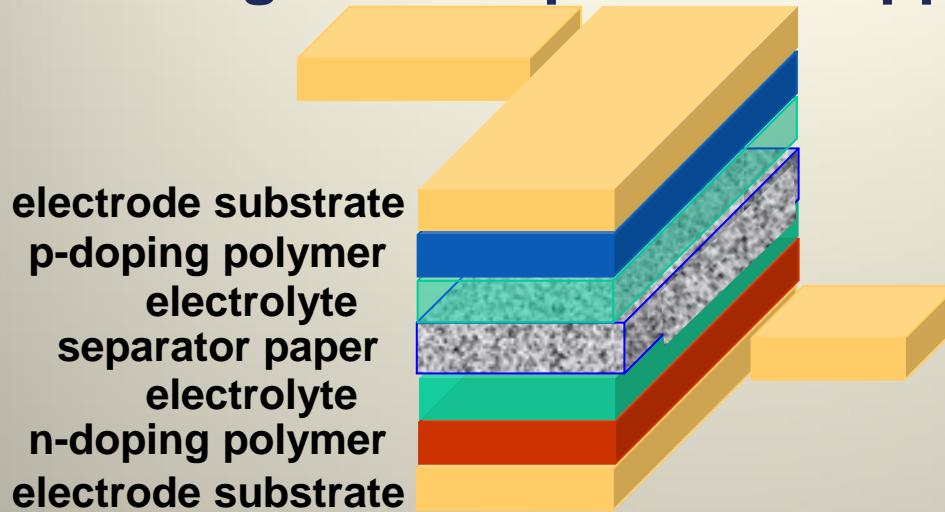
These cells are smaller than a credit card

Power Density
- Currently 625 Watts/kg
- Cathode improvements could double this

Charge Time
- Under a minute; more studies needed.

Stability/Hold Life
- In inert atmosphere, devices are quite stable; good hermetically sealed packaging will be crucial.

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Face Recognition Process

Feature Descriptor (SIFT) detects and extracts local feature descriptors that are reasonable invariant to:

– Changes in scale, 2D translation and rotation illumination, image noise and viewpoint.

SIFT keypoint detector is not invariant to illumination changes.

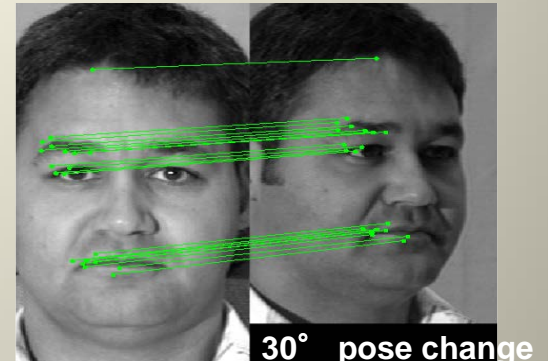Highpass filtering + adaptive thresholding ensures adequate number of descriptors per image.

Keypoint selection with original SIFT method, 120 points

30° pose change

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Face Recognition Process
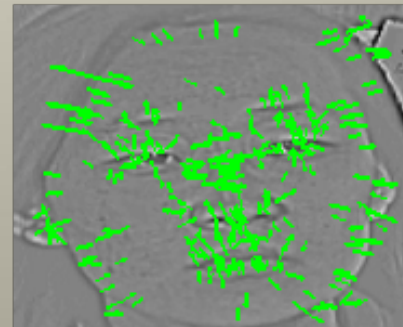
30° pose change

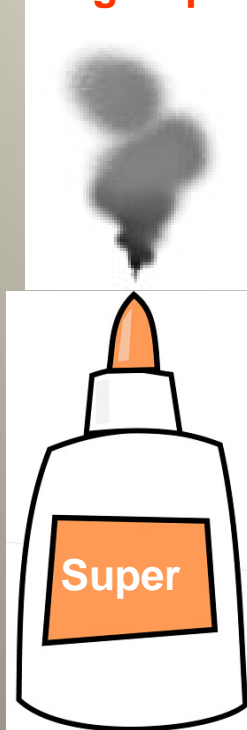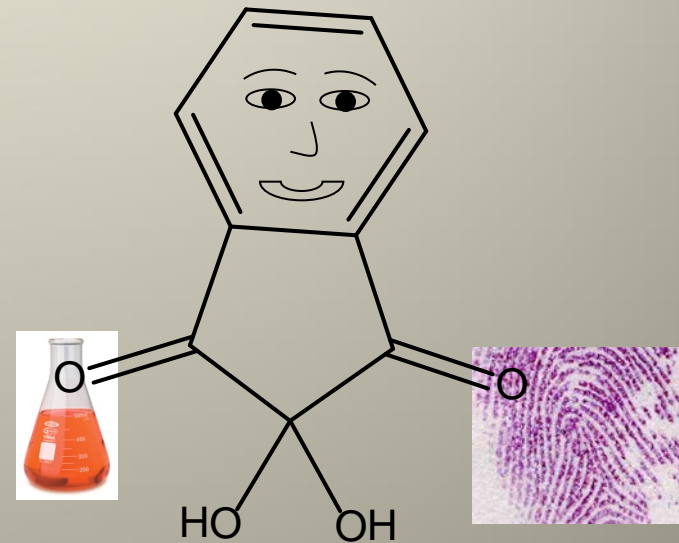30° pose change

30° pose change
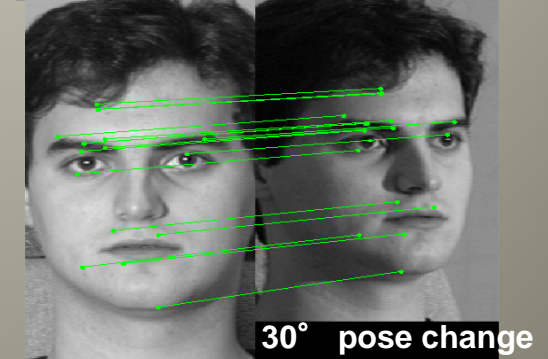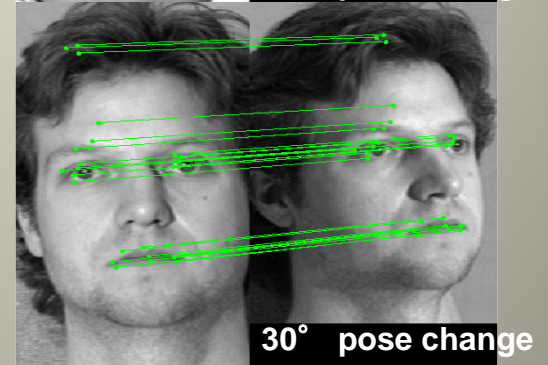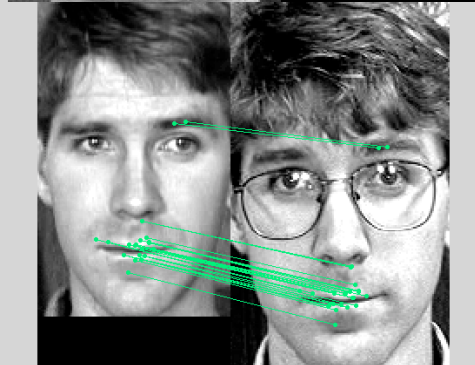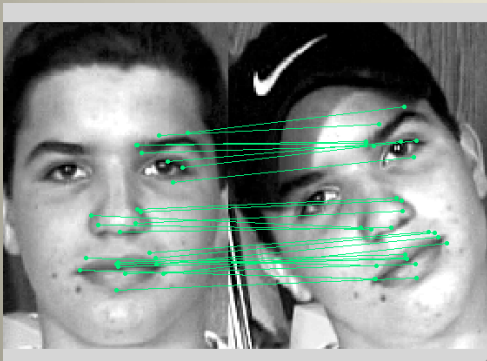
Fumeless Latent Fingerprint Detection

Current Methods of Latent Fingerprint Development
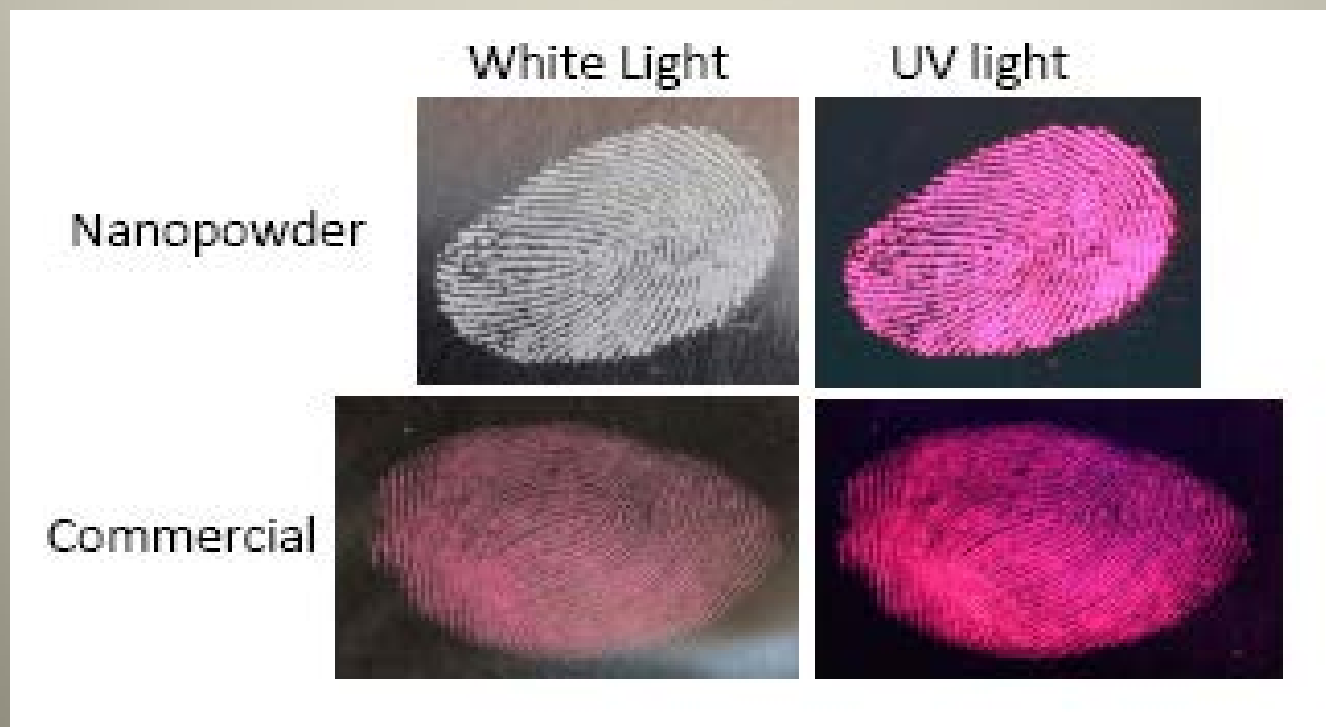
Fuming Super Glue

Ninhydrin

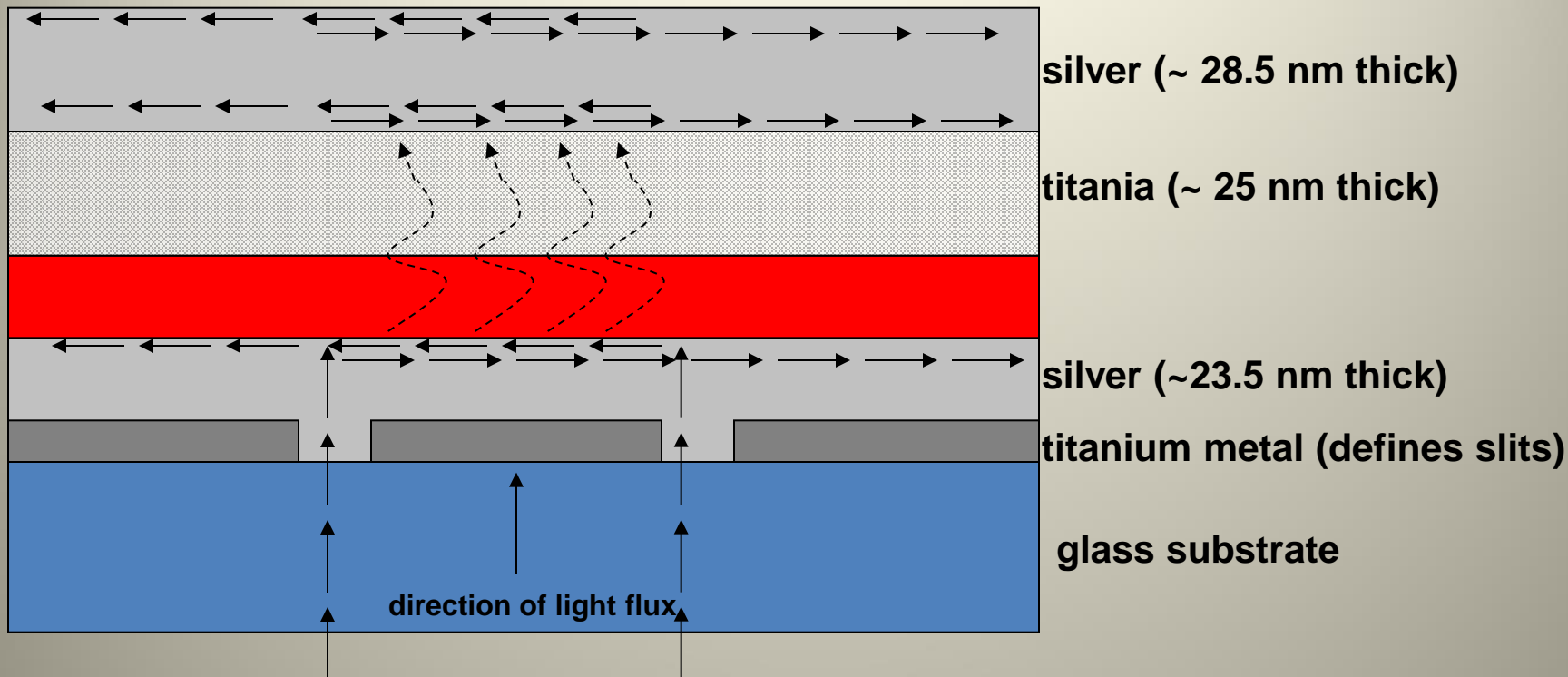# Fumeless Latent Fingerprint Detection

Commercial / Alternative applications

Detection of latent finger, nose, and paw prints for crime scene evidence collection and military applications.

Nanoplasmonic Cavities for Photovoltaic Applications

silver (~ 28.5 nm thick)

titania (~ 25 nm thick)

silver (~23.5 nm thick)

titanium metal (defines slits)

glass substrate

direction of light flux

This invention traps sunlight by using resonant cavities tuned to each color of the rainbow (Navy Cases 101702 and 102115). The surface of titania is a well-known efficient charge-separation interface and serves to transport electrons. ALD produces high quality wide area films with nanometer control of thickness. Multi-layer nanostructures were fabricated by methods that have demonstrated capability for rapid scale-up for mass production of large area devices. China Lake's computer modelling of the transport of charge density waves through the nanofilm PV devices lead to this optimum device construct.

Small Object Detection Using Meaningful Features and Generalized Histograms

This invention is a new algorithm for detecting very small objects in imagery. The algorithm applies the Helmholtz principle which is a new paradigm for applying the gestalt theory of human perception to computer vision applications. The Helmholtz classifier eliminates dependence on tuning parameters and thresholds. It was developed by the LOGIR program to detect and track small boats in sea clutter and wakes, with no minimum contrast level.

# System and Method for Time-Space-Position-Information (TSPI)
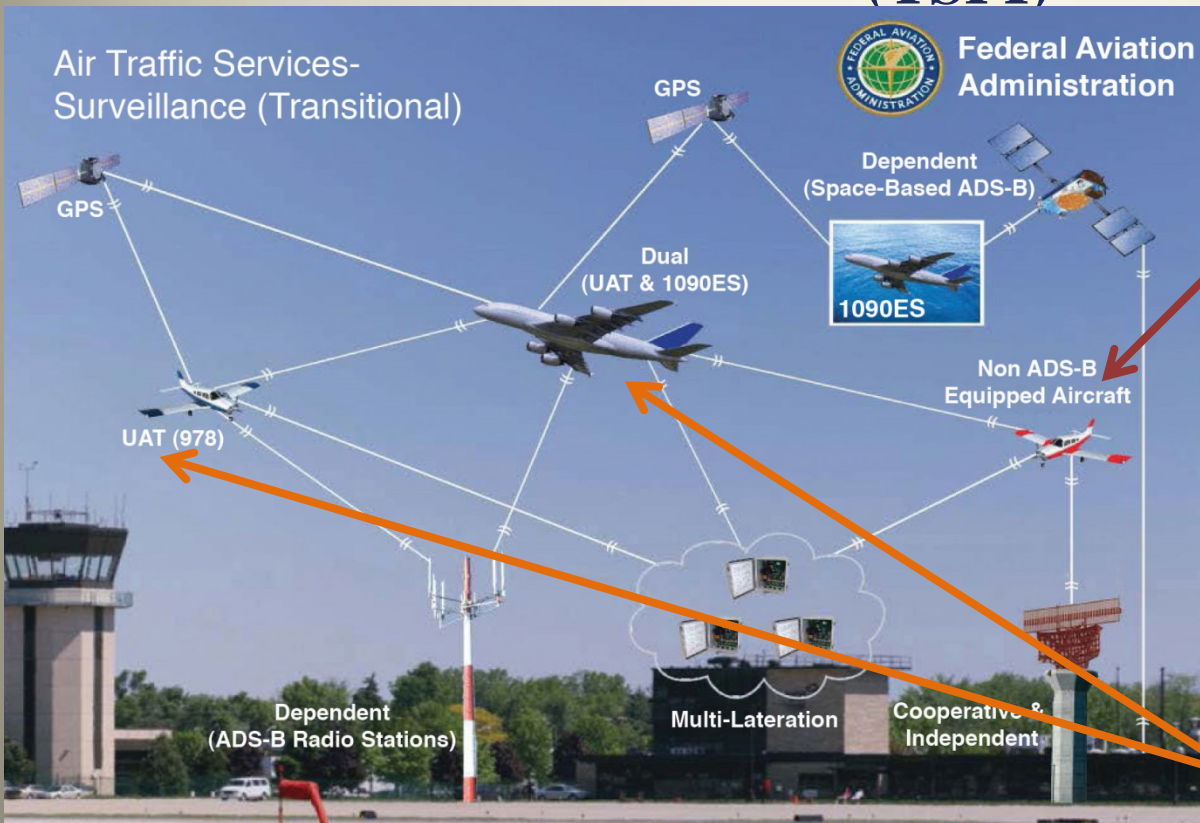
TSPI architecture could allow a low cost, size weight and power (c-SWAP) option for non ADS-B manned and unmanned air vehicles to operate in NextGen, e.g. using L-band

- **UAT, Distance Measuring Equipment (DME) or 1090 could support ground-based pseudolite role, Ref: "Pseudolite Alternatives for Alternate Positioning, Navigation, and Timing (APNT)," Sherman Lo, Stanford University.**
- **Geolocation of air vehicle transmitter signal in ground station provides an additional independent APNT solution, maybe enabling phase out of expensive ground radar systems.**

GPS represents a single point of failure for many applications. While occasional outages or periods of unreliability may be acceptable for some applications like auto navigation, applications such as air vehicle flight require extreme levels of precision, availability and integrity. Triple redundancy, precise and reliable positioning reusing existing communication signals for navigation. Possible game-changer to FAA Next Generation Air Transportation System (NextGen) offering more cost-effective and reliable alternatives for positioning of air vehicles for air traffic management and control.

Perpendicular Drive Mechanism for Missile Control Actuation System

FIG. 1A
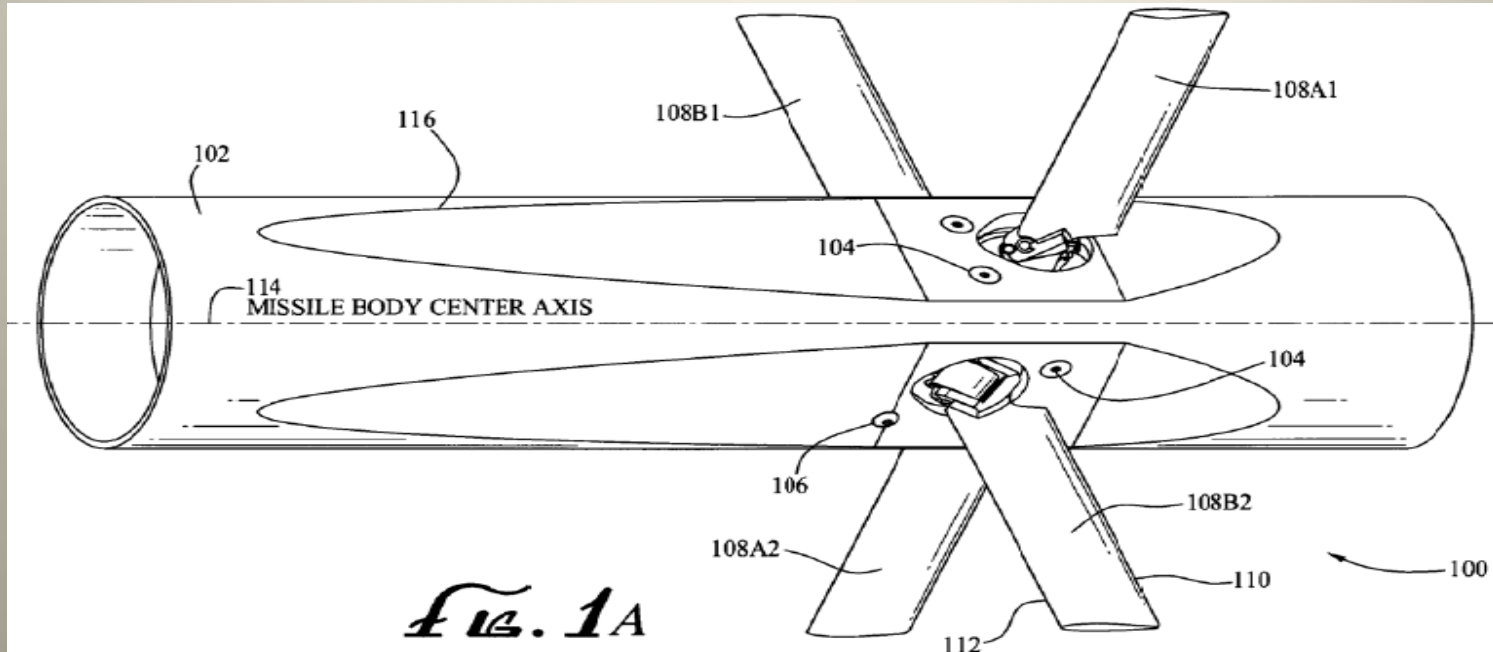
This is a guided missile control actuation system (CAS) to drive mechanisms having lead screws perpendicular to a missile body center axis. This solves the problem of actuating the aerodynamic control surfaces of a missile or similar guided vehicle. The CAS drive mechanisms include higher efficiency, lower backlash, more accurate measurement of control surface positions, higher load capacity, and increased ease of assembly. These are small, low-cost, high-speed, high-precision missiles because it makes optimum use of limited space to (1) withstand relatively large forces generated by aerodynamic loads on control surfaces and (2) provide high torque with high efficiency and low backlash and (3) it accomplishes this with a minimum number of components.

Level Set Tree Detection

I_{t-1} I_t I_{t+1}

Binary Map of $C(z) > t$ Moving Object Detection

- Level Set Tree Detection allows for very fast computations by exploiting the topological structure of the data.

- Applications: Coherent motion

Level Set Tree Detection

Color Segmentation of Peppers Image

- Level Set Tree Detection allows for very fast computations by exploiting the topological structure of the data.
- Applications: Color feature extraction

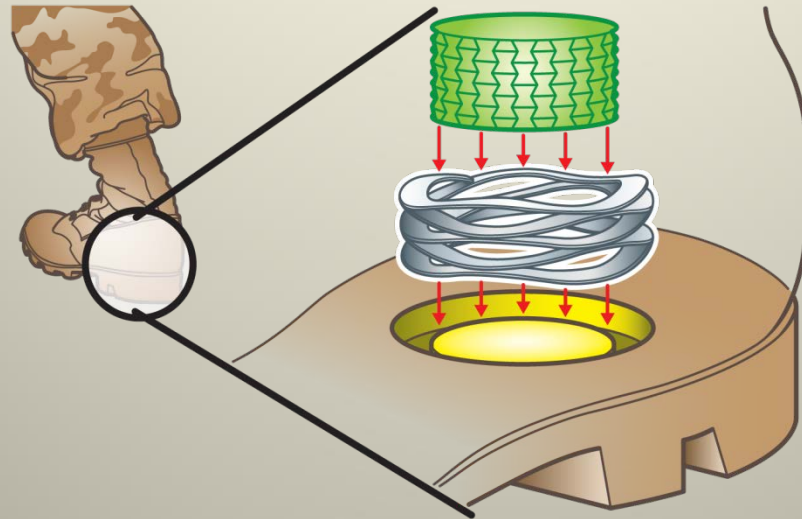# Level Set Tree Detection

Changes Outlined in Blue
- No false changes
- All the "actual" changes were detected

- **Level Set Tree Detection allows for very fast computations by exploiting the topological structure of the data.**

- **Applications: Change Detection**

NAV AIR

Energy Harvesting Device Using Auxetic Materials

Most materials have positive Poisson ratio (expand under compression). Auxetic materials have internal structure which imparts negative Poisson ratio property (contracts under compression). Auxetic materials have the potential to exponentially increase the energy harvesting ability (U.S. Patents 9,048,761 and 9,030,079) of dielectric elastomer generator, triboelectric, and piezoelectric systems. These materials have potential applications for motion energy harvesting including human motion, ambient vibration, wind-driven motion, and wave motion.

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Top Patents with Commercial Potential!