

How to make multi sensor CMM's easier to use and less costly

(Ongoing and future developments in hardware and software)

- 0) Trend in using CMM's 1980 - 2010
- Ia) Hardware: Sensors (new solutions)
- Ib) Standards: OSIS (only use Sensors you need)
- II) Software: more Multisensor CAD based programming (less training)
- III) Software: more Functional Gages (reduce scrap in manufacturing)
- IV) Software: more Feature based measurement (less training)
- V) Standards: I++ (use Software you need)
- VI) Standards: Uncertainty in Measurement (know accuracy for ALL measurements)
- VII) Using strategy generators for sensor path generation
- VIII) Reduce complexity of existing Standards and Norms
- IX) Cost of ownership

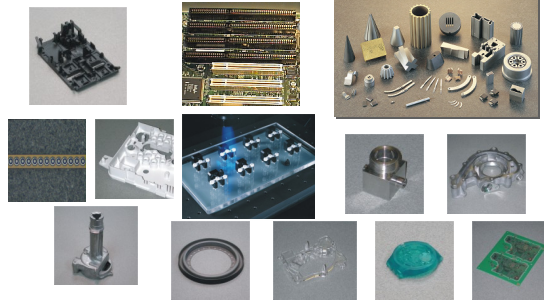


How to make Multisensor Metrology system easier to use and less costly
Karl J. Lenz

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0) Trend: Why Multisensor ?

parts get more complex and smaller



consequence: more sensors (more consultancy)



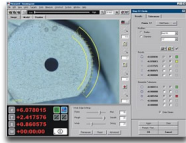
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Why Multisensor: Video probes

Video Camera with part surface illumination

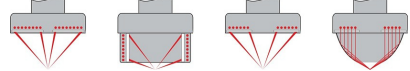
Video image



Measures

- 2D contours by edge scanning
- 3D topography by multifocus
- edges
- Arc's, Lines, circle
- Height (in z)

part surface illumination



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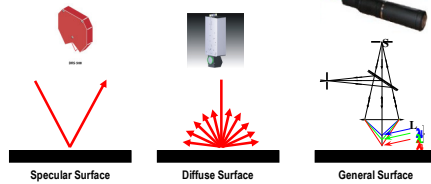
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Why Multisensor: Optical Point probes

Different Surfaces Require Different Techniques

laser

white light



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Why Multisensor: Tactile Probes

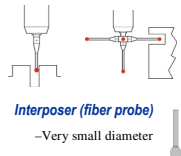
Proven Technology

Touch Trigger

- Great variety of probe tip diameters and stylus lengths
- Interchangeable stylus modules and change racks

Very low force probe

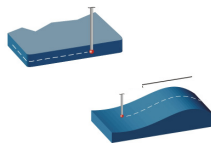
- Liquids, adhesives,
- Silicon wafers, Contact lenses



Interposer (fiber probe)
-Very small diameter

High Speed Continuous Contact Scanning

- Scan unknown surfaces
- No prior knowledge of form required
- Simply select start and end points
- Solves complex 3-D challenges
- Higher order curves
- B-splines
- Similar to video edge trace

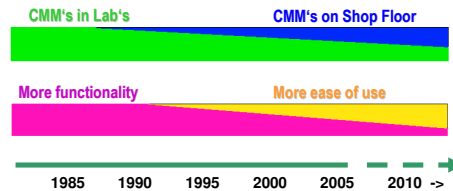


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0) Trend in using CMM's 1980 - 2007(1)

Tactile CMM's, video based CMM's, Multisensor CMM's

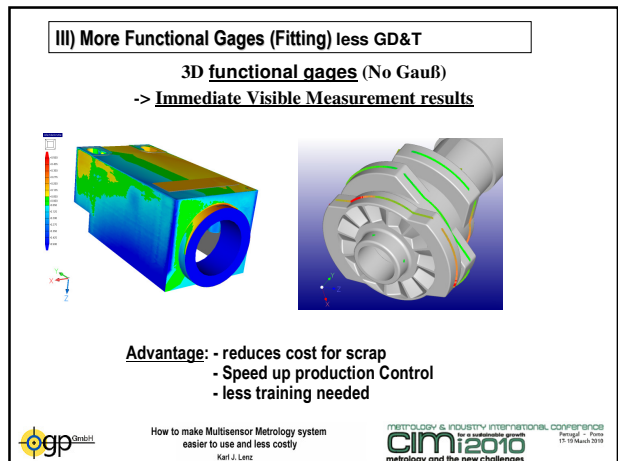
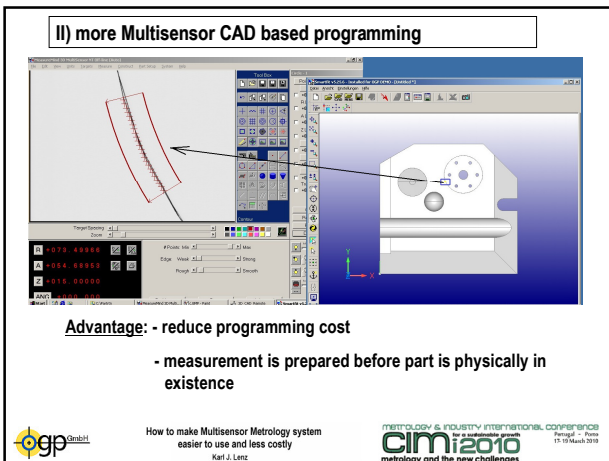
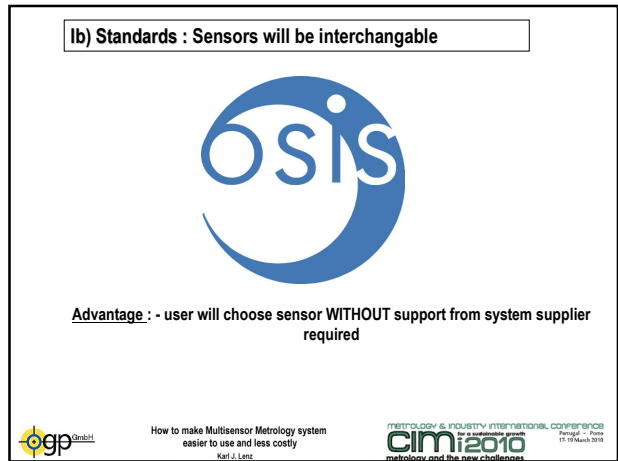
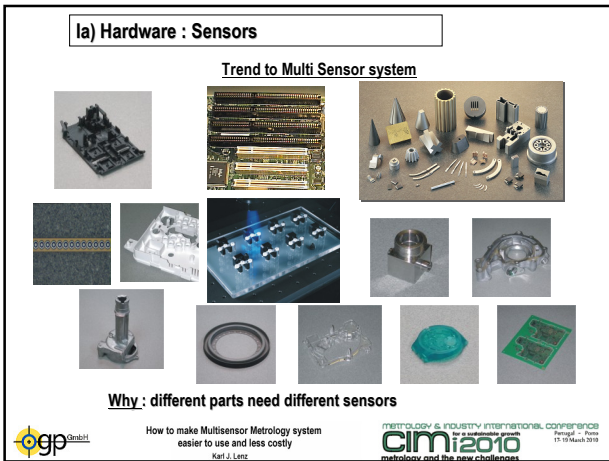
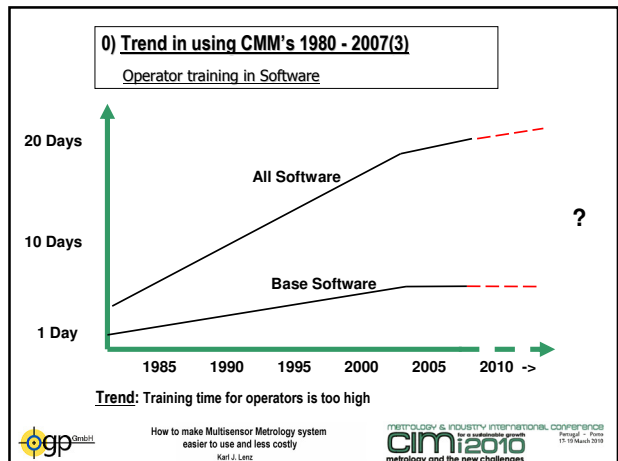
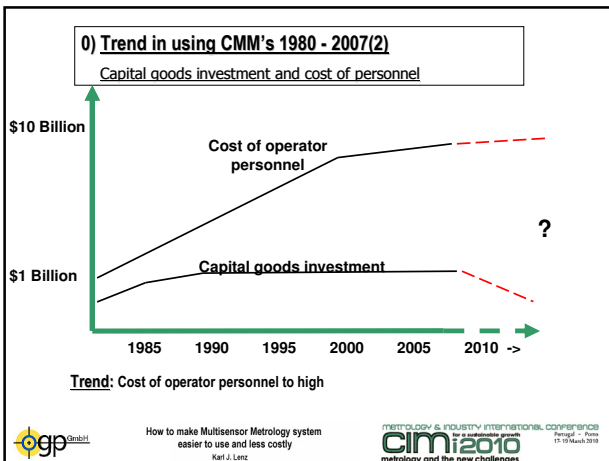


consequence: systems and software are radically changing
(more system consultancy, less operator training)



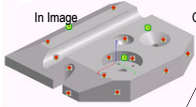
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IV) More Feature based measurement

Select Features



Or List

Feature	Min/Max	F-Pos	S-Pos
Step 7	Fac: 0.01	0.0000	0.0000
Step 10	Pro: 0.02	0.0000	0.0000
Step 11	Pro: 0.02	0.0000	0.0000
Step 12	Pro: 0.02	0.0000	0.0000
Step 13	Pro: 0.02	0.0000	0.0000
Step 14	Pro: 0.02	0.0000	0.0000
Step 15	Pro: 0.02	0.0000	0.0000
Step 16	Pro: 0.02	0.0000	0.0000
Step 17	Pro: 0.02	0.0000	0.0000
Step 18	Pro: 0.02	0.0000	0.0000
Step 19	Pro: 0.02	0.0000	0.0000
Step 20	Pro: 0.02	0.0000	0.0000
Step 21	Pro: 0.02	0.0000	0.0000
Step 22	Pro: 0.02	0.0000	0.0000
Step 23	Pro: 0.02	0.0000	0.0000
Step 24	Pro: 0.02	0.0000	0.0000
Step 25	Pro: 0.02	0.0000	0.0000
Step 26	Pro: 0.02	0.0000	0.0000
Step 27	Pro: 0.02	0.0000	0.0000
Step 28	Pro: 0.02	0.0000	0.0000
Step 29	Pro: 0.02	0.0000	0.0000
Step 30	Pro: 0.02	0.0000	0.0000
Step 31	Pro: 0.02	0.0000	0.0000
Step 32	Pro: 0.02	0.0000	0.0000
Step 33	Pro: 0.02	0.0000	0.0000
Step 34	Pro: 0.02	0.0000	0.0000
Step 35	Pro: 0.02	0.0000	0.0000
Step 36	Pro: 0.02	0.0000	0.0000
Step 37	Pro: 0.02	0.0000	0.0000
Step 38	Pro: 0.02	0.0000	0.0000
Step 39	Pro: 0.02	0.0000	0.0000
Step 40	Pro: 0.02	0.0000	0.0000
Step 41	Pro: 0.02	0.0000	0.0000
Step 42	Pro: 0.02	0.0000	0.0000
Step 43	Pro: 0.02	0.0000	0.0000
Step 44	Pro: 0.02	0.0000	0.0000
Step 45	Pro: 0.02	0.0000	0.0000
Step 46	Pro: 0.02	0.0000	0.0000
Step 47	Pro: 0.02	0.0000	0.0000
Step 48	Pro: 0.02	0.0000	0.0000
Step 49	Pro: 0.02	0.0000	0.0000
Step 50	Pro: 0.02	0.0000	0.0000

Select Features Protocol

Step	Feat	Min/Max	F-Pos	S-Pos	Deviation	Exceeded
Step 10	Feat 1	0.0000	0.0000	0.0000	0.0000	OK
Step 11	Feat 2	0.0000	0.0000	0.0000	0.0000	OK
Step 12	Feat 3	0.0000	0.0000	0.0000	0.0000	OK
Step 13	Feat 4	0.0000	0.0000	0.0000	0.0000	OK
Step 14	Feat 5	0.0000	0.0000	0.0000	0.0000	OK
Step 15	Feat 6	0.0000	0.0000	0.0000	0.0000	OK
Step 16	Feat 7	0.0000	0.0000	0.0000	0.0000	OK
Step 17	Feat 8	0.0000	0.0000	0.0000	0.0000	OK
Step 18	Feat 9	0.0000	0.0000	0.0000	0.0000	OK
Step 19	Feat 10	0.0000	0.0000	0.0000	0.0000	OK
Step 20	Feat 11	0.0000	0.0000	0.0000	0.0000	OK
Step 21	Feat 12	0.0000	0.0000	0.0000	0.0000	OK
Step 22	Feat 13	0.0000	0.0000	0.0000	0.0000	OK
Step 23	Feat 14	0.0000	0.0000	0.0000	0.0000	OK
Step 24	Feat 15	0.0000	0.0000	0.0000	0.0000	OK
Step 25	Feat 16	0.0000	0.0000	0.0000	0.0000	OK
Step 26	Feat 17	0.0000	0.0000	0.0000	0.0000	OK
Step 27	Feat 18	0.0000	0.0000	0.0000	0.0000	OK
Step 28	Feat 19	0.0000	0.0000	0.0000	0.0000	OK
Step 29	Feat 20	0.0000	0.0000	0.0000	0.0000	OK
Step 30	Feat 21	0.0000	0.0000	0.0000	0.0000	OK
Step 31	Feat 22	0.0000	0.0000	0.0000	0.0000	OK
Step 32	Feat 23	0.0000	0.0000	0.0000	0.0000	OK
Step 33	Feat 24	0.0000	0.0000	0.0000	0.0000	OK
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Step 37	Feat 28	0.0000	0.0000	0.0000	0.0000	OK
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Step 42	Feat 33	0.0000	0.0000	0.0000	0.0000	OK
Step 43	Feat 34	0.0000	0.0000	0.0000	0.0000	OK
Step 44	Feat 35	0.0000	0.0000	0.0000	0.0000	OK
Step 45	Feat 36	0.0000	0.0000	0.0000	0.0000	OK
Step 46	Feat 37	0.0000	0.0000	0.0000	0.0000	OK
Step 47	Feat 38	0.0000	0.0000	0.0000	0.0000	OK
Step 48	Feat 39	0.0000	0.0000	0.0000	0.0000	OK
Step 49	Feat 40	0.0000	0.0000	0.0000	0.0000	OK
Step 50	Feat 41	0.0000	0.0000	0.0000	0.0000	OK

- Advantage:**
- substantial reduction of programming time
 - worker selects Features to be measured
 - Training 10 minutes



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V) Standard I++ : Software will be hardware independent

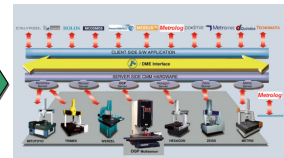
Metrology Systems from different Vendors in ONE Company

Typical Today: Software A, Software B, Software C



Now with I++: ONE Enterprise software only

Examples: RETROTEC (Verano, RETROTEC Prolog), CALIPSO (Dino), PROTECTOR (Catal, CALIPSO Prolog), PROTECTOR (Catal, CALIPSO Prolog), and a growing number of other vendors



- Advantage:**
- user selects software and systems independent
 - higher performance
 - less people

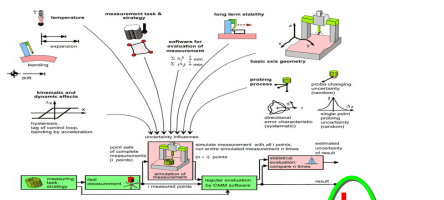


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VI) Standards: Uncertainty in Measurement

Virtual CMM



Step	Feat	Min/Max	F-Pos	S-Pos	Deviation	Exceeded	Status
1	Q1	2.450	2.470	2.490	2.465	-0.004	OK
2	W1	0.600	0.605	0.610	0.604	-0.004	OUT

- Advantage:** Enables users to make the commercially right decisions

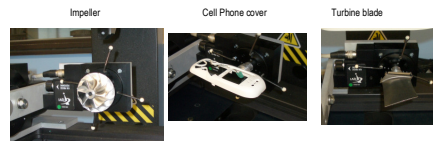


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VII) Use of strategy generators (Sensor movement automatically created by CAD and measuring task)

Especially Required for line and area sensors - Timeframe until 2015-2020



- Why:** can reduce metrology program creation time by 50 to 90% AND increases Accuracy



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Major trend:

VIII) Reduce Cost of ownership

- Customers will only invest in machines where the cost of ownership is less than today

How?

- Software will be dramatically simpler to use than today
- CAD based Multisensor CMM -> base training

1 day training



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IX) Reduce complexity of existing Standards and Norms

Examples: ISO 1101, Gear standards, ISO 17025 accreditation procedures, etc

Why?

- to help small companies to use modern Metrology equipment without to much administrative burden

How?

- National bureaus of standard, Universities, Standard committees have to review the existing Standards and Norms

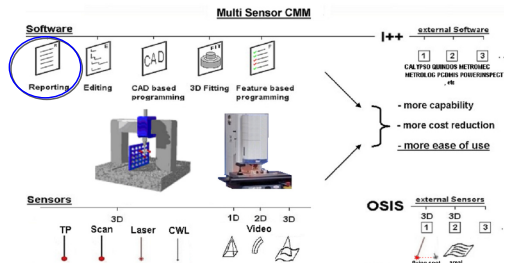


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**Conclusion: more sensors more ease of use
reduces cost**



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