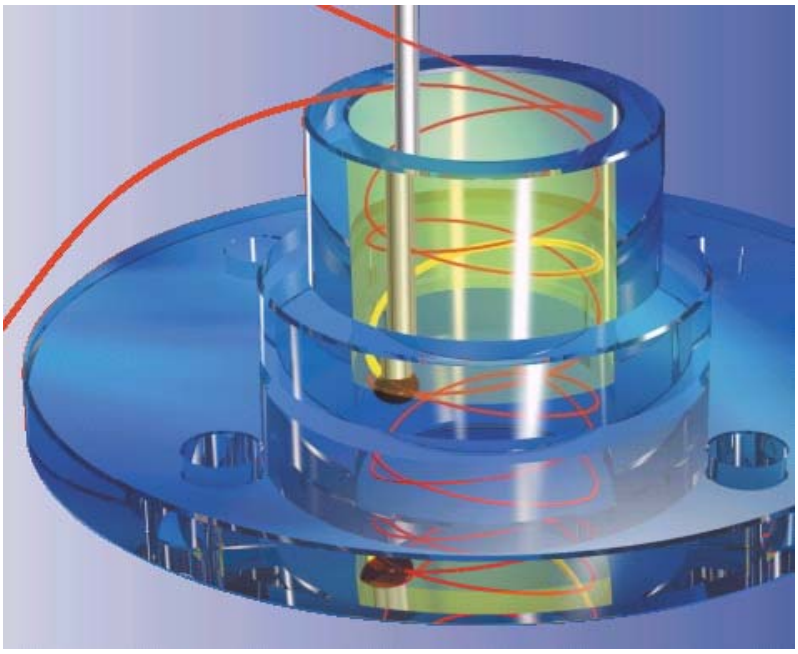
CMM´s, How to find the right system.

It is less complicated then it seems

Modern QC asks for more universality, flexibility and automatisaion. Tasks were cmm´s are especially sucsessful, because of their wide efficiency spectrum. They are useable for various measuring tasks and parts, with low measuringuncertainty compared with other means. On the other hand, there is much uncertainty to choose the right system for the own application, because the user is confronted with difficult seeming questions.

Cmm´s contact, with suitable sensors, surfacepoints of the workpiece to be measured, relativ to a spacious reference coordinatesystem. From all points, belonging to one geometry, the size, form and position is calculated with the help of suitable software. Software also allows to do statistics, curvemeasurement against cad-data or digitising surfaces. Herewith cmm´s recommend themselves to measure small precision parts, for the calibration of master parts and measuring gages, but also car-bodies.



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But it ist this flexibility of the cmm´s, that creates the uncertainty on the user site, what is the best system for me. Is the configuration chosen, able to really solve my problems, or is it bigger than nessecary. Offers the system enough options for the future or does it reach its limits soon? Is a taktile or an optical sensor better for my tasks? Questions over questions….
Indeed, cmm´s are very complex systems of high technology and neary infinite possibilities.
This lets the seem difficult on the first glance to choose the right systen for the own applications. But only on the first glance, with a structured method, the task becomes relatively easy.

The most important criterions for the selection.

Not to miss the overview, it is suggested to concentrate on the substantial criterions.
The main reference is the part spectrum to be measured, it´s sizes, tolerances and the given measuring tasks.
Further define, how fast and in which form the measuring results shall be created and where shall they be processed. Where is the cmm installed? Who operates it? Which preperations are nessecary for the measurements?
After these points are clear, the selection of the right cmm can start with the following scematic.

1. design
2. accuracy and enviroment
3. sensors
4. control
5. software
6. technological competence and services of the maker (ia.cmm membership)
7.

Horizontal and vertical arm machines : The designs

Most cmm´s work in katesian coordinates. They have three slides , x,y,z ,vertical to each other. Normally the shaft carries the sensor, which contacts the workpiece. Each axis

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contains a measuringsystem with high accuracy and resolution to determin the position of the axis. The most used designs are horizontal arm and bridge typs. Besides of this there are some cmm´s with articulating arms.

Cmm´s for machined parts mostly use the stable bridge design, because of the lower tolerances. For sheet metal, plastic and casted parts, often the horizontal arm design is prefered. Besides these basic design, special designs are used.
The lengths of the axis neaded, are determined from the largest parts and how deep the probes have to move inside the parts from all sides, to reach necessary points to measure, or the workingdistance of optical probes. The different design also have different needs for space and accessebility, two quite important factors.

Sensitive topics: accuracy and enviromental conditions

The accuracy is possibly the most important characteristic of a cmm, and is defined by the length-measuring- uncertainty. It defines, how much of the tolerance in the drawing is left for the production. The smaller the uncertainty of the cmm is, the more tolerance the production has to use. Higher accuracy normally means higher investment for the cmm. The investment should always be regarded together with the costs for the production machines and the effords necessary for the enviromantal conditions of the cmm.
For cmm´s with tactile sensors, the length-measuring- uncertainty, normally is defined in the direction of the axix and in space, under defined conditions of temperature and viberation, including the sensor with a short vertical probe..
During practical measurements however there are longer and horizontal probes, probechangers, swiveling joints, rotary tables a.s.o. used, to reach all nessecary points. All these components have an additional influence to the reachable length-measuring-uncertainty. It is important, to add this influence to the basic spec.
To garantie the user compareable values, the working group cmm-specifications of ia.cmm prepares, at this time, a equal specificationsystem, relevant for all member companies of ia.cmm.

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Care is nessecary about deformation of the workpiece by the clamping means and the workpiece temperature. As long as the workpiece temperature is constant over the whole workpiece, it can be measured and taken care of by software. This is already one simple possibillity of correction to acieve lover uncertainty. The essential task however is, to take care of the systematic deviations of the reference coordinatesystem despite highest mechanical precision possible.

There are various technologies, starting to select certain materials for single mechanical components, reaching to complicated softwareprogramms for correction. Which means the maker uses, is his decision. He has to make sure, that he reaches the given spec.
More important for the user is, to choose the suitable sensors for his tasks.

With feeling and perspicacity, tactil, optical or combined: the sensors.

Simply spoken, the sensors serve to contact the measuring points on the workpiece.
Depending on the measuring task, tactile and non contact sensors are used.

Tough trigger probes are the most used sensors. They detect single points with high accuracy, for instance in holes, to determine the diameter, the position of the centre and the axis a.s.o. Are more points taken, than minimal nessesary, you can get an first information about form errors.

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Scanning probes, are able to take points of short distance in short time, and are used to measure f.i. the flatness of planes, roundness and cylindricity of holes, curves, gears turbineblades, dies a.s.o.

Optical triangulation sensors are offered as trigger and measuring sensors. They measure the distance to a plane in one direction without contact. The measuring version offers to scan a surface non contact.

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Image analisys sensors also work non contact. They detect many points out of the projection of an edge on a CCD sensor. It depends on the optical magnification of the sensor, which area of the workpiece can be detected at the same time with the highest speed. To position the sensor in the right working distance, often triangulation sensors are used. Typical application are toolmeasurements, edges of sheetmetal parts and small or soft parts which are hard to contakt tactil. A lot of applications are in the electomechanical industry.

Multisensortechnology: If a workpiece needs various sensors to be measured, they can be arranged by sensor changers or by using a cmm with more than one shaft, each carriing a certain sensor.

The control unit: manual or CNC

By the control we devide cmm´s in three groups:

1. Manual handled on the axis or on the sensor. They are normally used for short measuring tasks without any preparation or for a programmed measuring cycle in the production. This machines often use touch trigger probes.
2. Motorised axis, handled by joysticks are used for larger cmm´s for application like 1.
3. Cmm´s with motorised axis and CNC control, automatically run the preprogrammed measuring cycle. But they also can be manual handled.

The software: has many tasks

The user, first of all, has to choose the nessesary evaluation software for his purposes. Normally a standardprogramm belongs to the basic machine. Often, also basic programms for curve-measurement and statistics are integrated. The comparison between the standard programm and the own needs showes ev. nessesary additional evaluation software. There are programs for all different applications offered.

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The evaluation programs, developed from the various cmm makers are all very similar. The decision should be made on the own part profil and the own preference.
Following the evaluation programs, the dataimput and the dataprocessing has to be illuminated. It has to be cleared wether the desired programms are available or if the necessary interfaces exist.
Besides these tasks, the software supports nearly all components of the cmm, with the goal to increase their performance and takes care of a optimal teamwork of the complete system. Therefore the software has to be opimally tuned with all components. At the latest, at this point, a certain cmm qualifies it self not only by it´s technical data, but also through it,s harmony within it´s total concept and the given service enviroment.

The ia.cmm – membership: guarantee for best performance and advice

It is precisely, this harmony of the total concept, beginning from the perfected technologie up to the customer orientated philosophy, that the member companies of ia.cmm specified as their goal. This needs a qualified advise previous to the investment and an exellent service after the installation of the cmm. Even if the offered systems are naturally so various as the enormous possibilities of modern cmm technologie, with this hints, you are well prepared to start your discussions with the various makers. With the qualified and fair advice, the service and the support of the ia.cmm member companies, each company will find the really suitible cmm system.

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IA.CMM: International Association of Coordinating-Measuring-Machine-Manufacturers

Together to the future of cmm-technology

With residence in Zürich, the ia.cmm concentrates on several important tasks: Education and training, promotion and introduction of common standards for the user interface. Definition of modern standards and methods for technical tests, service and user education.

The ia.cmm offers to be a competent and activ partner for all international organisations and working-groups in the cmm- technologie. The member companies guarantee their users worlwide, to specify their products according to international standards and the results of the ia.cmm workinggroups. For the promotion of the dialog between engineers, managers and users of cmm´s, ia.cmm offers a continuing forum for exchange of this groups.

Important groups, cooperating closely with ia.cmm are OSIS, I++/DME and AUKOM.

More information about our common work, the users and interested parties can get in a special conference, held during the control excibition i2003 in Sinsheim. Further information about the conference and about the ia.cmm and it´s members under www.iacmm.org.

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