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# Isomorph srl at Elrob2008

*Isomorph srl* is a spin off company (founded in 2003). We produce new solutions and products based on innovative physics research..

**Our major contribution to Elrob2008 consists in a new technology of pattern recognition: “linear computing”. Linear computing allows to construct universal pattern recognition systems (robotic brain). Robotic brains are the precondition for autonomous robots.**

**We would need about 8 months to get our software operational on advanced military systems.**

In this paper we want to present:

1) Pattern recognition based on linear computing

Our robotic brains understand what they are seeing, like a human being does. For instance, they can recognize human beings in a non controlled environment and without motion detection. This cannot be achieved with conventional systems.

2) Three dimensional (3-D) reconstruction of complex scenes

Linear computing is ideally suited for stereo 3-D reconstruction. At present, our system is based on the use of two video cameras only (passive system). But additional cameras can be added. It is as well possible to use infrared cameras.

3) Our experience with the CELL processor (IBM):

The CELL is fast even with conventional software. With linear programs it becomes a true digital divide.

4) A new generation of robots:

The principles of linear physics can also be applied to hardware problems: we can construct for you a totally new kind of highly mobile, cheap and very fast robot.



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## 1) Pattern recognition

A precondition for a truly autonomous robot is a universal pattern recognition system. Up to today, universal pattern recognition systems exist in science fiction only, like for instance in the movie Terminator 2:



The reason is, that under the paradigm of conventional information theory, the pattern reconstruction - or computer vision problem cannot be solved:

*>>The field of computer vision can be characterized as immature and diverse ... there is no standard formulation of "the computer vision problem". Also, and to an even larger extent, there is no standard formulation of how computer vision problems should be solved. Instead, there exists an abundance of methods for solving various well-defined computer vision tasks, where the methods often are very task specific and seldom can be generalized over a wide range of applications.<< (wikipedia, 2008)*

We have developed a new physics theory of information, which is described in a separate paper. It allows to calculate the description of an image using the tools of Boolean Algebra – without approximations, without calculating probabilities, without decision making and without training procedures. In theory, this is a universal pattern recognition system.

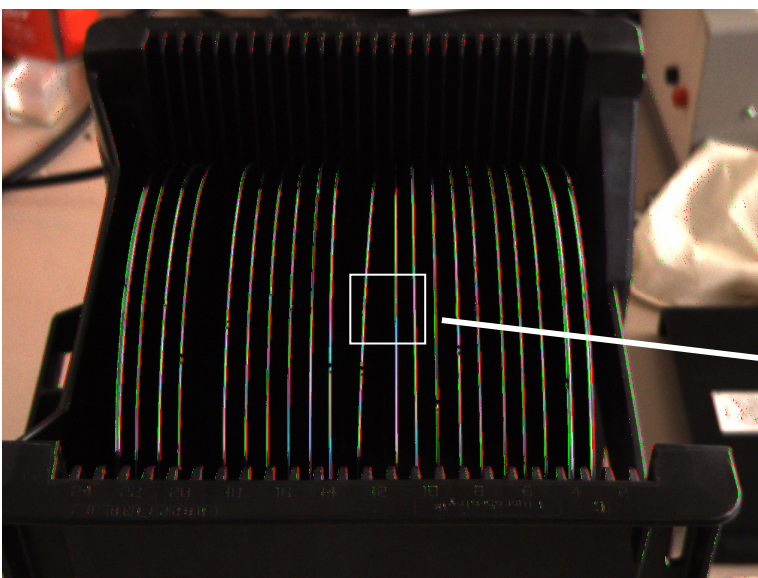


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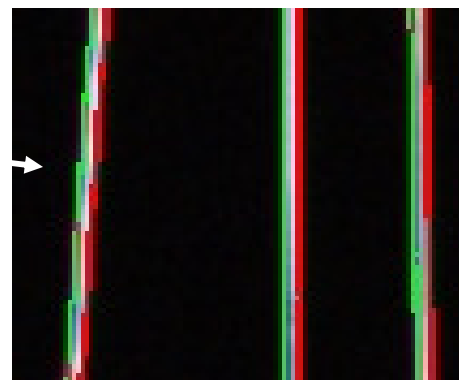
In practice, we can identify complex objects in complex environments, for instance human beings in non controlled environments. The following evaluation is performed on single photographs, without motion detection:



Our programs have not yet been applied on the battlefield, but they are already successful in industrial production for performing tasks of *total quality control*: This system for the monitoring of silicon wafers in transport carriers was developed for *Infineon* (Dresden) and was shown to be superior to the state of the art systems.



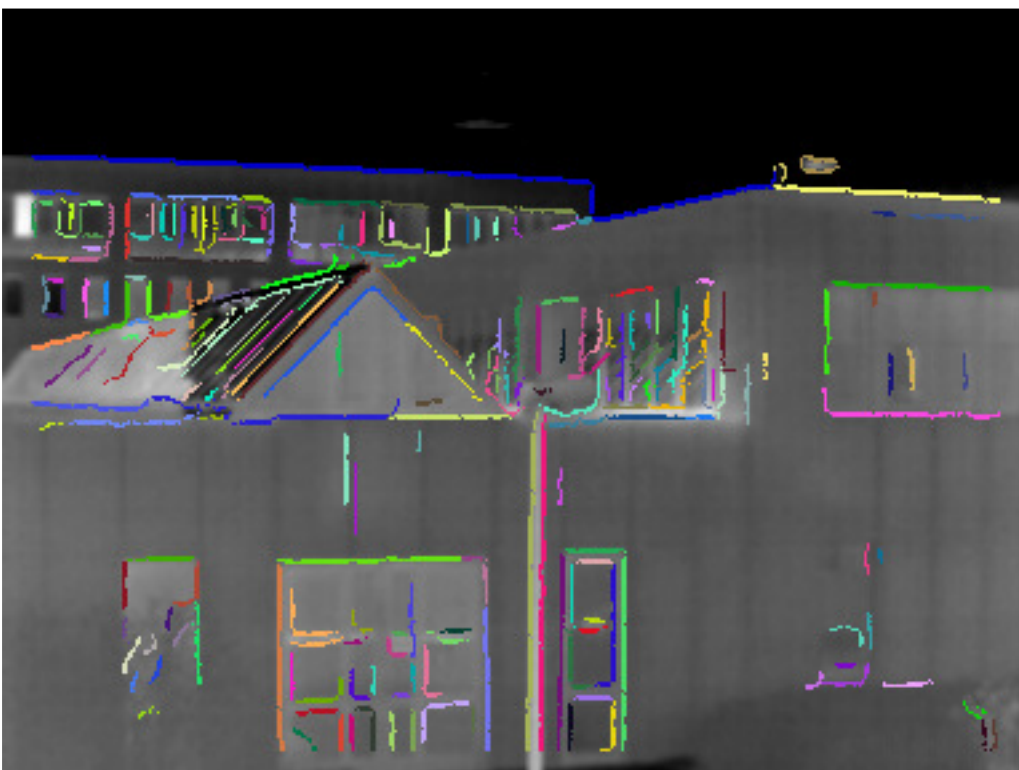
Each wafer is recognized from a total of about 1000 elements, ordered into left (green) and right side (red). That is almost as good as the human brain can do.





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Our technique can also be applied to images from infrared cameras:



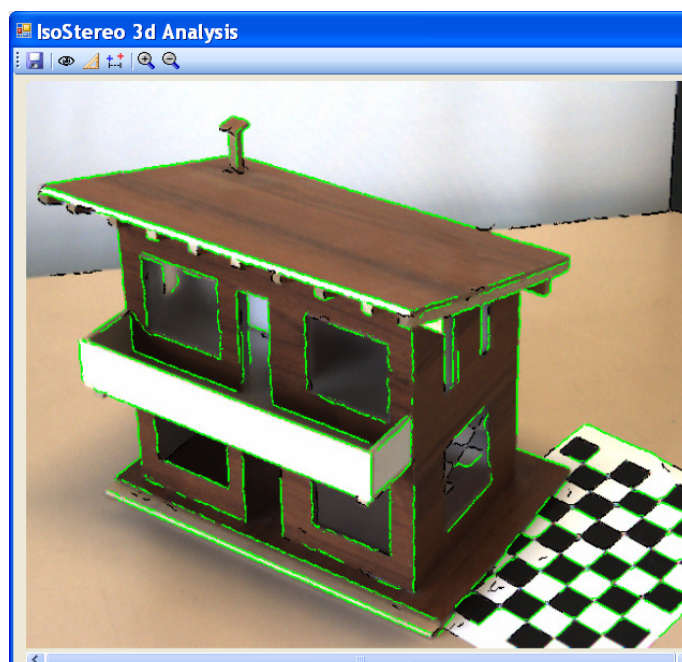
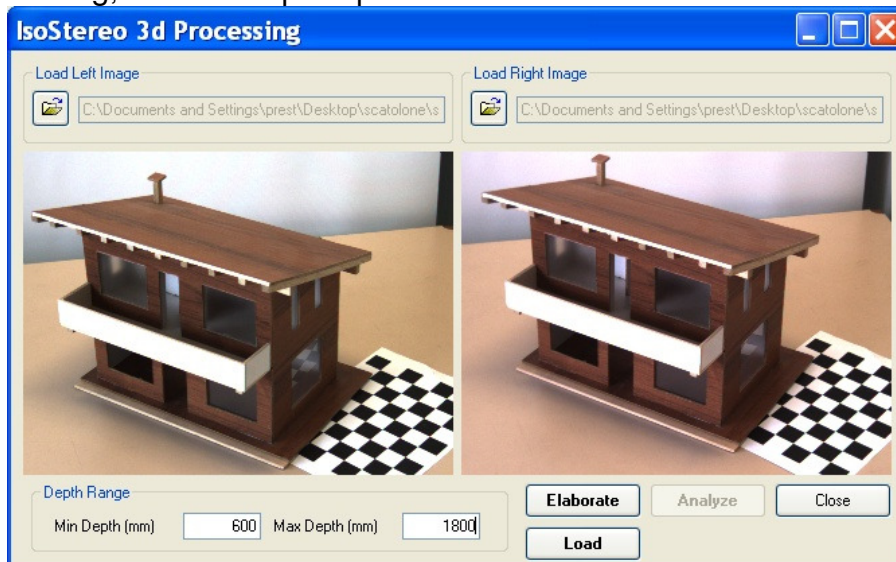


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## 2) 3-D reconstruction of complex scenes

Our program IsoStereo3D performs a high precision reconstruction of three dimensional scenes. It is based on two stereoscopic images. IsoStereo3D is a product, which you can download from our web site.

Since IsoStereo3D has a linear structure, it can be upgraded substantially (its complexity will not increase exponentially, but linearly with the complexity of the problem to be solved). For instance we can include additional cameras, we can much improve the reconstruction routines and we can combine it with high level specific pattern recognition features. The system could provide you in real time a detailed 3-D model of what your robot is seeing, with a sub-pixel precision.

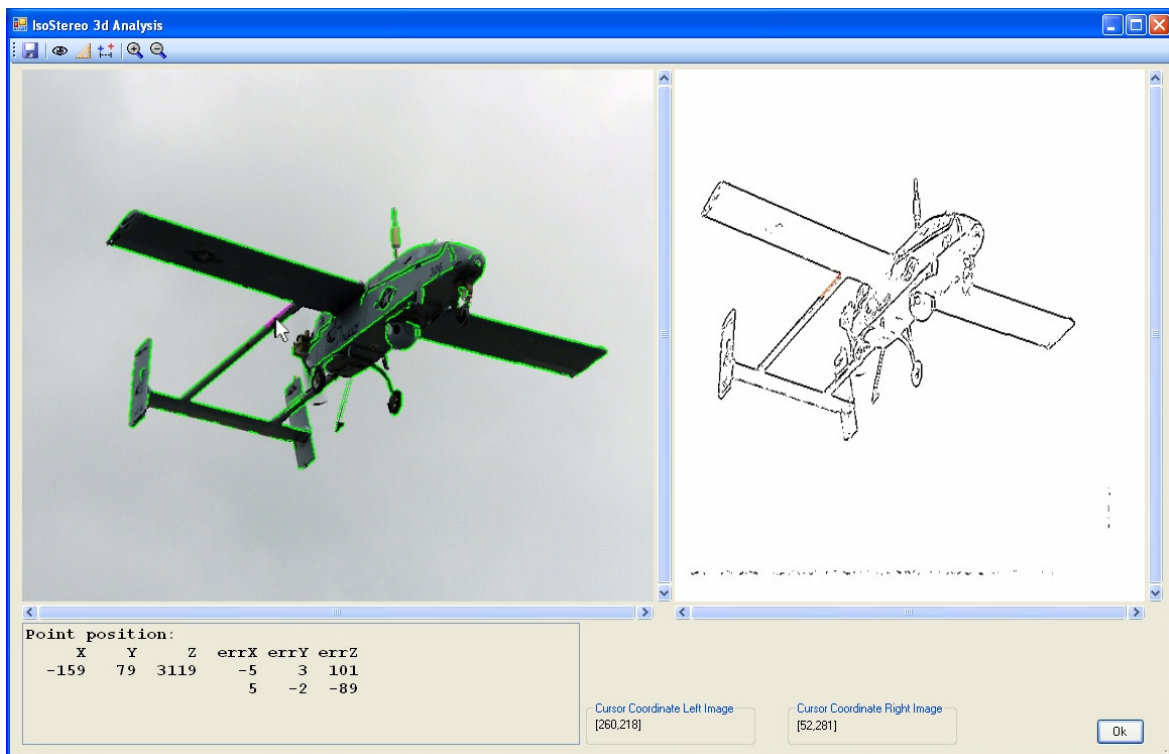




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## UAV detection

Isostereo3D also allows to detect, to identify and to locate moving objects, also small moving objects like UAVs (passive detection).





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### 3) Our experience with the CELL processor (IBM)

While we developed the new theory of linear computing, IBM, Sony and Toshiba were developing the CELL processor. From our point of view the CELL is the first significant step away from a von Neumann architecture towards a linear computer.

Therefore the CELL is ideally suited for our programs. We can at present identify a human being in about 0.2 seconds in a coloured stereo image (using the CELL in a Playstation3).



In this example the CELL operates on two video cameras and recognizes the presence of human beings in real time. The 3-D position of the person and the position of his arms are communicated to a standard rendering routine, which creates an avatar at the same position in virtual space and with the same gesture



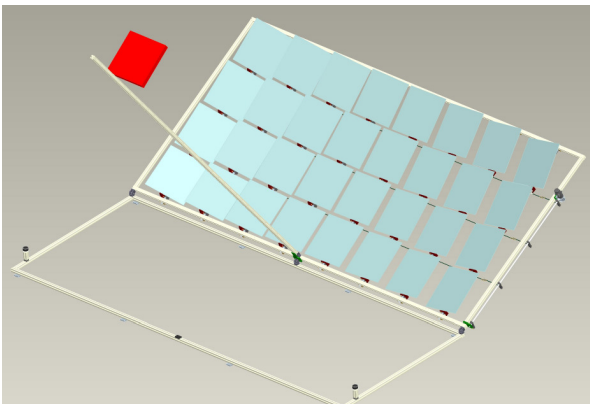
Up to now, such a performance did exist only in science fiction. Adapting the program to military requirements and integrating it in an advanced robotic system could be done in less than a year.



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#### 4) A new generation of robots

The physics of information shows, that each system can be made linear. This is also true for any kind of hardware. For example we have developed a concentrating mirror system, which is much simpler than conventional systems and therefore much less expensive. It operates with any number of mirrors using only one electrical motor (during the day). The motor performs a simple movement, linear in time.



This concentrating mirror system is about 3 times cheaper than the state of the art systems, because it is linear.

Similar arguments can be made for robots:

Isomorph has a concept for a new generation of highly mobile robots, cheap to build, very fast and with little energy consumption. We could not yet patent the concept due to a lack of resources. But we can build you a linear robot, if you give us the resources.

Our vision of future robots:

- they will move faster than human beings
- they will react faster and with a higher precision
- they will be cheap and energy efficient.