Hierarchical ReID from Elegant Mathematics

Elegant Mathematics LLC (USA) &
Elegant Mathematics Ltd (Germany)

https://www.em-radiant.com/
https://www.elegant-mathematics.com/
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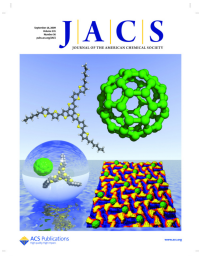
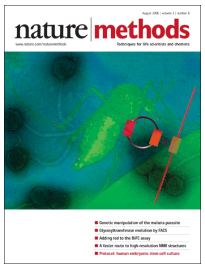




Elegant Mathematics Ltd (Germany) and its branch **Elegant Mathematics LLC** (USA) represent an exceptional company specializing in contract R&D and the production of high-tech solutions in the fields of chemistry, physics, and computer science. At the forefront of the industry since 2006, our roots trace back to 1991 when our American office received its first order from Cray Research Inc for the development of rapid parallel algorithms for solving systems with sparse matrices.
From our inception, we have been actively engaged in contract software development and electronic equipment component design. Our achievements encompass successful collaborations with prominent companies such as ExxonMobil, Sodern, NXP, Western Atlas, Robert Bosch GmbH, Northrop Grumman, and Nvidia. We conduct contract research and development for corporate clients, prestigious European universities, and research centers, spanning diverse areas of science and technology.

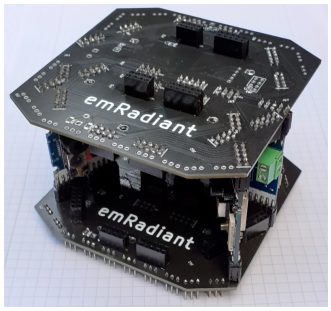
CRAY RESEARCH, INC. ExxonMobil sodern arianeGROUP | neutron technology NXP
BOSCH WESTERN ATLAS NORTHROP GRUMMAN NVIDIA

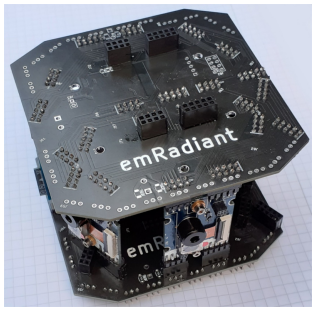
Key Areas of Expertise:

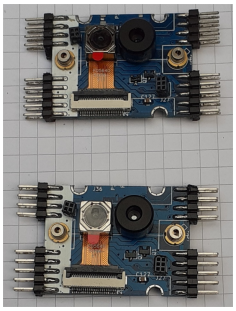
- **Computer Vision:** Creating cutting-edge computer vision systems for various applications.
- **Scientific Electronics:** Developing precise scientific electronics capable of tackling complex challenges.
- **Software Development:** Engineering software solutions for scientific equipment, industrial electronics, and analytical chemistry.

One of our key technologies that we conceptualize, develop, and manufacture is the **emRadiant** computer vision system.

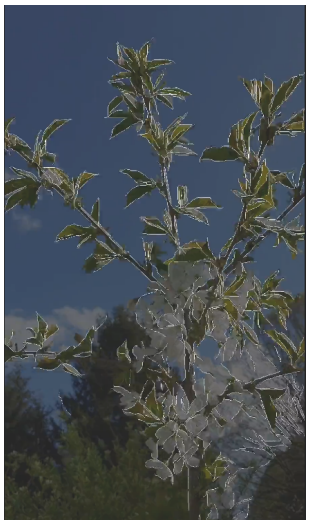
emRadiant comprises simple and lightweight blocks capable of real-time segmentation and localization of surrounding objects, without the need for access to large external databases or cloud services. It's important to note that each block is equipped with an impressive array of sensors, totaling up to 13 different sensor types. We also offer custom solutions for cases with lower power consumption requirements and for tasks where block weight is crucial.








The key idea of the **emRadiant** mini-system lies in preprocessing incoming information from cameras and sensors using real-time edge detection algorithms and data from all available sensors. This system achieves a comprehensive understanding of its environment, allowing for enhanced object detection and localization.



These compressed data are further processed by built-in distributed computing modules, resulting in reduced power consumption and overall system costs. With 13 different sensor types in each block, the **emRadiant** system stands out as a versatile and comprehensive solution, enabling efficient and cost-effective real-time analysis of its surroundings.

We develop specialized algorithms that utilize this information.

These preprocessed data can easily be applied to solve tasks such as:

- Simultaneous Localization and Mapping (SLAM).
- Object recognition and state identification in industrial environments.
- Hierarchical object recognition.

Rapid identification and tracking of moving objects are crucial in the modern world. Such tasks are addressed to prevent collisions in autonomous vehicle movement, achieve precise positioning of industrial equipment, enhance security, and address various other challenges.

The key approach we employ involves the method of hierarchical object description:

- Imagine having a photograph where an object can be identified and localized. We store this information in the initial structure of the object.
- By obtaining several photographs of the object from different perspectives and comparing the initial structures of objects using sensor information, we can probabilistically match these structures. During this matching process, we can refine information about the object, improve the clarity of the surface image, and identify changes in the object's form.

This hierarchical structure does not require training on specific samples and allows the accumulation of all available information about the object for subsequent reidentification.

We actively apply such algorithms to extended SLAM tasks where surrounding objects can also move and change its shapes.

For example, one of the solutions we propose is installing the **emRadiant** system on several drones that autonomously move through unknown areas, mapping and recognizing various objects, including mobile ones. Each drone dynamically makes decisions about movement based on the already obtained data, recognizes each other to avoid collisions, and avoids collisions with moving objects in close proximity to such an area.

More information about our company can be found on our corporate website http://www.elegant-mathematics.com , and details about the computer vision system and its application algorithms are available at https://www.em-radiant.com .

Our drones are BlueUAS certified.

Our small yet highly motivated team has experience working with DARPA and is currently participating in the DARPA Triage Challenge Systems Competition.

We possess all the necessary equipment for conducting local tests, and our team members are certified by CITI-Program (Human Research, Group 1 Biomedical).

We are ready to collaborate, bringing expertise and flexibility in the fields of computer vision, SLAM, and hierarchical object identification. We would be delighted to consider any proposals for mutually beneficial collaboration to successfully contribute to the VideoLINCS project.