

# SCO Program/Product Report



## CNE emalign

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*Cluster-optimized software tools for alignment of Zeiss multi Scanning Electron Microscopy (mSEM) acquired 3D datasets.*

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## I. Summary

This is a collection of software tools to support CNE's emalign pipeline on the HPC cluster.

## II. Description

### a. Image Cross-Correlation Module (rcc-xcorr)

Repository: <https://github.com/research-center-caesar/rcc-xcorr>

This component performs a series of cross-correlations on a specified batch of images and templates and returns the best template matches for each image.

The code contains various implementations such as sequential CPU, single-node parallel CPU, multi-node parallel CPU, single GPU, single-node multi-GPU and multi-node multi-GPU. The code is parameterize to allow the caller to optionally specify the implementation to be used. The module includes a test harness that verifies the accuracy of the output as well as timing infrastructure to measure and report the execution time as well as the top bottlenecks.

The code implements a stateless and side-effect-free interface. Code optimizations include: change of order of image-template cross correlations in order to maximize data reuse in caches and GPU memory.

## III. Development History

### a. Meetings

Date	Attendants	Outcomes
2021-11-10	Omar Valerio (SCO) Paul Watkins, Eric Jelli (CNE)	<ul style="list-style-type: none"><li>Defined API for Image Cross-Correlation Module</li></ul> <p>The INPUT would be the following:</p> <ol style="list-style-type: none"><li>1. A list of images. The images are passed as float arrays. (This is a constraint from emalign.)</li><li>2. A list of templates. Also passed as floats.</li><li>3. A list of cross-correlations: between images and templates.</li></ol> <p>The OUTPUT would be a list with:</p> <ol style="list-style-type: none"><li>1. Peak cross correlation value (float).</li><li>2. The 2D indices of the peak location with respect to the image.</li></ol>

### b. Program Increments

<b>Program Increment 1</b> Components: Cross-Correlation Module Duration: 6 weeks (2021-12-27)	Status
1. Perform batch of (image, template) correlations using open-source CPU correlation in Python3 with no ordering optimization and on a single CPU core	Open
2. Benchmark execution time of baseline CPU open-source-based implementation	Open
	Open

<ol style="list-style-type: none"><li>3. Document API, implementation, benchmark results</li><li>4. Test harness that calls the module using known outcomes and verifies the accuracy of the output</li></ol>	Open
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## IV. Performance Results

TODO