



MaLibU: Open-Source Math Utility Library for Medical Augmented Reality Unity Applications

Project Management and Software Development
for Medical Applications

General Info

Contact Person: Tianyu Song, Kevin Yu, Michael Sommersperger, Alexander Winkler

Contact Email: tianyu.song@tum.de,
kevin.yu@tum.de,
michael.sommersperger@tum.de,
alexander.winkler@tum.de

Project Abstract

Augmented reality (AR) solutions have gained popularity in computer-integrated surgeries, as they can provide intuitive visualizations of medical data directly at patients' site and Unity [1] is a cross-platform game engine powering many of them. The graphical interface and many convenient built-in features allow developers to prototype and create applications easily. However, there are only a few functionalities regarding numerical computations provided. Although some third-party libraries can be imported to expand the ability for mathematical calculations, none of them offers the commonly used algorithms in computer aided medical procedures. The goal of the project to build an open-source **Math utility Library** for Medical Augmented Reality Unity Applications (MaLibU).

Background and Motivation

In computer aided medical procedures, algorithms such as pivot calibration, point cloud registration, hand-eye calibration are often used. However, they are usually implemented in a C++ or Python environment. In Unity, C# is the programming language used, therefore implementations via libraries like Math.Net [2] and Alglibnet [3] are preferred.

Many AR developers and researchers including the past and current PhD students at CAMP have implemented their own versions of the mentioned algorithms for AR applications. However, the interfaces and dependencies are inconsistent, increasing the complexity of reusing the code.

The outcome of this project will be a free open-source library published on either Unity Asset Store or GitHub. It will benefit the future students from Medical Augmented Reality course to accelerate their implementations, and many more.

Student's Tasks Description

The student will need to build on top of the existing math libraries and implementations from CAMP. The student will implement basic linear algebra functions, various calibration, filtering, image processing algorithms. A test-driven development approach should be used, as the correctness of the implementation should be guaranteed. Any existing code can be reused, as long as a consistent interface is created. If external libraries or code is used, the license needs to be compatible

The student will learn how to build an open-source library, various commonly used algorithms for computer-integrated surgeries and medical augmented reality applications.

Technical Prerequisites

The student should be familiar with Unity and C#.

Basic knowledge of computer vision and augmented reality is required.

Basic knowledge of marker tracking, and calibration is not necessary but preferable.

Please send the completed proposal to ardit.ramadani@tum.de, lennart.bastian@tum.de and tianyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.



References

[1] <https://unity.com>

[2] <https://numerics.mathdotnet.com>

[3] <https://www.alglib.net>

[4] <https://github.com/zalo/MathUtilities>

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