

# Overview

AMASS (**AD**Tech **M**otion **A**nalysis **S**oftware **S**ystem) is a software package for deriving the three-dimensional (3D) locations of passive targets (unidentified markers) imaged by any number of video cameras, and writing the identified data to file using the [C3D file format](#). Input data are the marker centroids expressed in each camera's image coordinate system, and a small number of parameters. The full AMASS software and documentation is available as a free download for evaluation purposes, but a wand must be purchased if you wish to use AMASS within your application.

In the current context we restrict ourselves to imaging and extracting 3D information on "points", and do not include surfaces or volumes unless they may be constructed from a multitude of "points". Physically every "point" has a finite extent and is usually defined by the location of a marker (or target). Typically markers are spherical for optimal accuracy but that is not a requirement, as for example with systems that use active markers (LEDs).

## A little history

The original AMASS was released in 1988 and presented novel solutions to issues such as camera lens distortions, camera system calibration, image data reduction, and integrated 2D and 3D marker tracking. It also introduced the [C3D file format](#) for identified 3D marker data that has become a standard for biomechanical applications, see [c3d.org](http://c3d.org). In 1995 AMASS introduced the first wand calibration that has now become the standard for passive marker systems. Since that time, computer, camera, and software technology has grown at a rapid pace to the point where an inexpensive desktop computer and off-the-shelf cameras can easily collect and process data from many cameras and create extremely large data files.

Unfortunately the ease-of-use of 3D measurement systems has not kept pace with hardware improvements, with the consequence that many commercial systems still have a steep learning curve and often require dedicated professionals for their effective operation. The reason for this is twofold:

1. The systems are inherently complex, involving camera and computer technology, optics, 3D geometry, and individual application requirements, and it is very difficult provide an integrated system that has the intelligence to reduce this complexity down to a point where the system can be easily operated by a novice user.
2. Many currently available software implementations are based on legacy software that is very difficult to modify without starting from scratch. An additional factor is that most modern software techniques (e.g. wand calibrations) are not in the public domain because they have been developed for proprietary use in commercial packages.

## Purpose

This completely new version of AMASS aims to provide the easiest-to-use software package that is theoretically possible, and much effort has gone into reducing the need for detailed user input, and into guiding the user throughout the process. An equal emphasis has been placed on the accuracy of the camera and system calibrations by use of a new type of wand which ensures optimal accuracy and facilitates reliable 3D reconstruction and tracking of markers. As such, it is expected that the package will find wide application in research laboratories, clinics, animation studios, and many

educational settings.

## Components

AMASS is comprised of two functional components:

- A multiple-camera system capable of imaging and recording “point” data.

C-Motion does not sell cameras but does provide [software](#) to control and record data from cameras that may be purchased from a number of manufacturers. This approach allows the user to optimize their choice of camera hardware with respect to price, availability, and functionality. Alternately the camera data required by AMASS may be collected using a number of commercially available motion capture systems. In this situation the raw camera data files need to be converted to files compatible with AMASS by use of an included utility, typically a simple one-step operation.

- AMASS software to calibrate the camera system and convert camera image data to point locations in 3D space.

The AMASS software accepts raw camera data files containing “point” image coordinates and, with the addition of a few simple parameters, carries out the computations to produce 3D locations of the “points” in the user’s desired coordinate system. The standard 3D data output from AMASS is via .c3d files. Initially the camera system must be calibrated by the collection of data on a “wand” moved throughout the measurement volume, and then running the Calibration program. The calibration wand is a specially engineered device supporting seven markers, and is supplied as a part of AMASS.

- Here are some [practical considerations](#) when using AMASS

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