

# OCAAT

(Open Cluster Automated Analysis Tool)

**Manual v1.0.0 (August 10, 2014)**

# 1 Introduction

This is the manual of operation for the `OCAAT` code.

## 2 Synthetic clusters

### 2.1 IMF sampling

The initial mass function (IMF) is the distribution of initial masses for a population of stars. For a population of  $N$  stars with masses  $m_i$  and a total mass of  $M_T$ :

$$\begin{aligned} IMF &\rightarrow \xi(m) = \frac{dn}{dm} \rightarrow dn = \xi(m)dm \\ M_T &= \sum_{i=1}^N m_i \rightarrow M_T = C \int_{m_l}^{m_h} m(n)dn = \\ &= C \int_{m_l}^{m_h} m\xi(m)dm \end{aligned}$$

where  $m_l$  and  $m_h$  are the mass limits for the IMF ( $m_h$  is fixed to  $100M_\odot$  in the code) and  $C$  is a normalization constant. Setting the total mass to unity,  $M_T = 1M_\odot$ , allows us to obtain the normalization constant  $C_1$  and treat the normalized IMF as a PDF:

$$M_T = 1M_\odot \rightarrow C_1 = \frac{1}{\int_{m_l}^{m_h} m\xi(m)dm}$$

and thus the normalized IMF can be written as:

$$PDF(m) = \xi(m)_{norm} = C_1\xi(m)$$

This is the first step, performed by the `get-IMF-PDF` function for a given selected IMF (Chabrier 2001, Kroupa et al. 1993, Kroupa 2002)

Once the PDF is generated, every time a new synthetic cluster is created the `get-mass-dist` function is called from within `synth-cluster`. This former function takes the PDF and samples a number of masses randomly from it, following the probabilities distribution given by the PDF, until the mass fixed by the `total-mass` parameter is achieved.

The `get-mass-dist` function thus returns a distribution of masses probabilistically sampled from a certain IMF, whose masses sum up to a total cluster mass.

## 3 Adding CMD support

In order to add support for a new CMD the following functions should be modified:

- `get-in-params`, add the label for the color.
- `get-isoch-params`, add the columns in the theoretical isochrone where the code should look for the filters used.
- `move-isochrone`, add the extinction equations that define how the this effect along with the distance modulus affect the magnitude and color in the CMD.
- `make-plots`, add name of the new filter in the integrated color plot block.