

An update of ICAP activities

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Joint Gaia ICAP-VSWG-Alerts
working group meeting
15-16 April 2004, IoA, Cambridge

ICAP activities 1

- completion of Blind Testing Cycle 2 (Brown, Jordi, et al.)
- optimization of photometric systems
 - Heuristic Filter Design (Bailer-Jones)
 - measures of filter system performance for stellar parametrization (Lindegren, Brown)
- classification algorithms for GDAAS
 - Single Star Parametrizer [simple MDM] (Bailer-Jones)
 - Discrete Source Classifier [Gaussian density estimation] (Christlieb)
- unresolved binary star detection/parametrization (Willemsen, Kaempf, Bailer-Jones)

ICAP activities 2

- thoughts on improvements of classification algorithms (ICAP-CBJ-007, -011)
- astrophysical parameter calibration stars (Soubiran)
- M-R-T calibrations for using absolute magnitude in classification (Malkov, Myakutin)

Heuristic Filter Design (HFD)

Goal: design a filter system to determine multiple APs across a wide parameter space subject to instrumental constraints

- conflicting demands on filter system
- manual design is complex; gives no idea of optimality
- cast as a mathematical optimization problem:
 - parametrize filter system (λ_{central} , $\Delta\lambda$, fractional integration time)
 - establish a figure-of-merit of filter system performance (using a grid of synthetic spectra, determine how well FS 'separates' the stars)
 - maximise this as a function of the filter system parameters (with an evolutionary algorithm)
- see A&A 419, 385-403 (2004)

HFD model

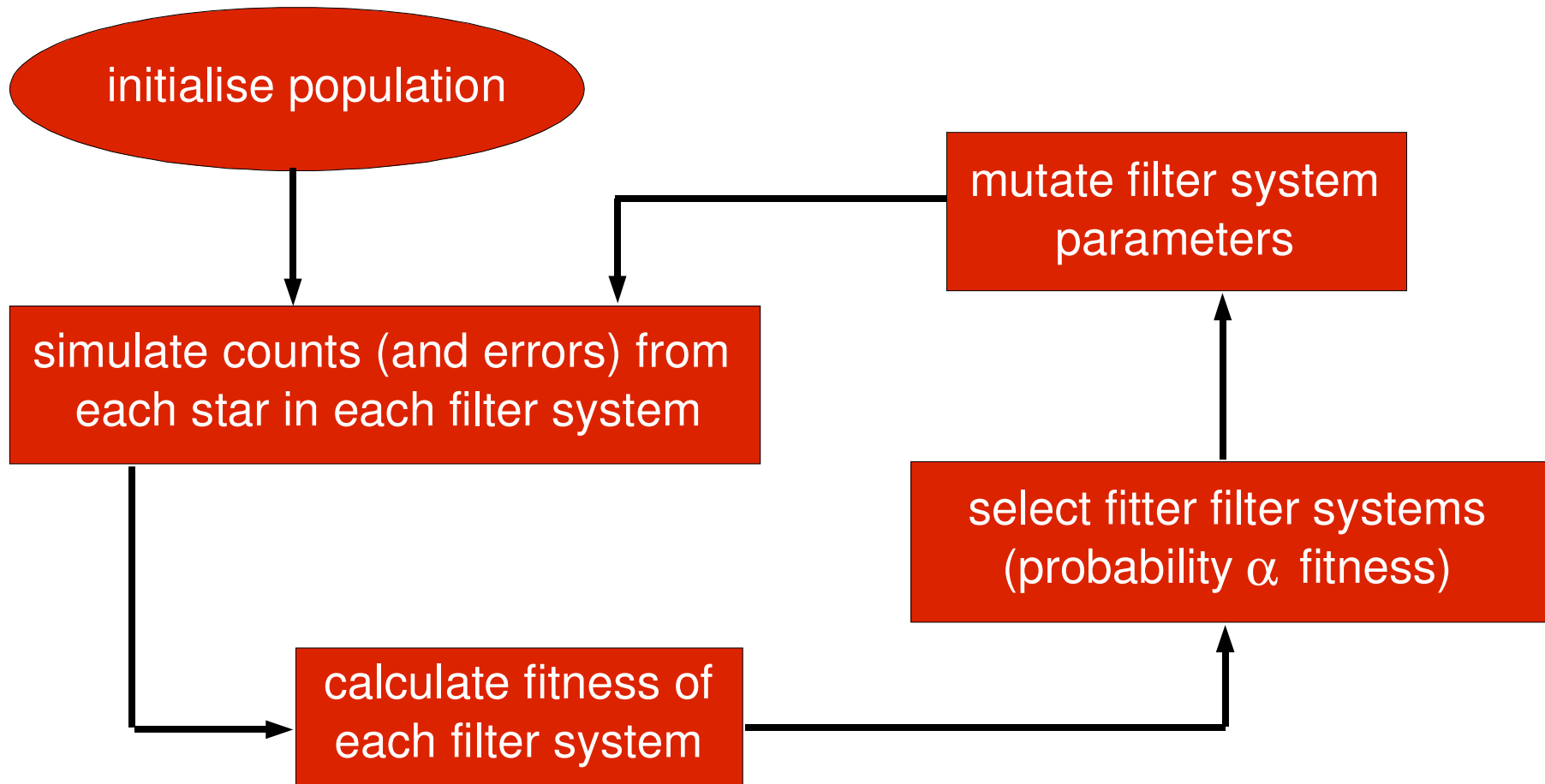


Figure-of-merit

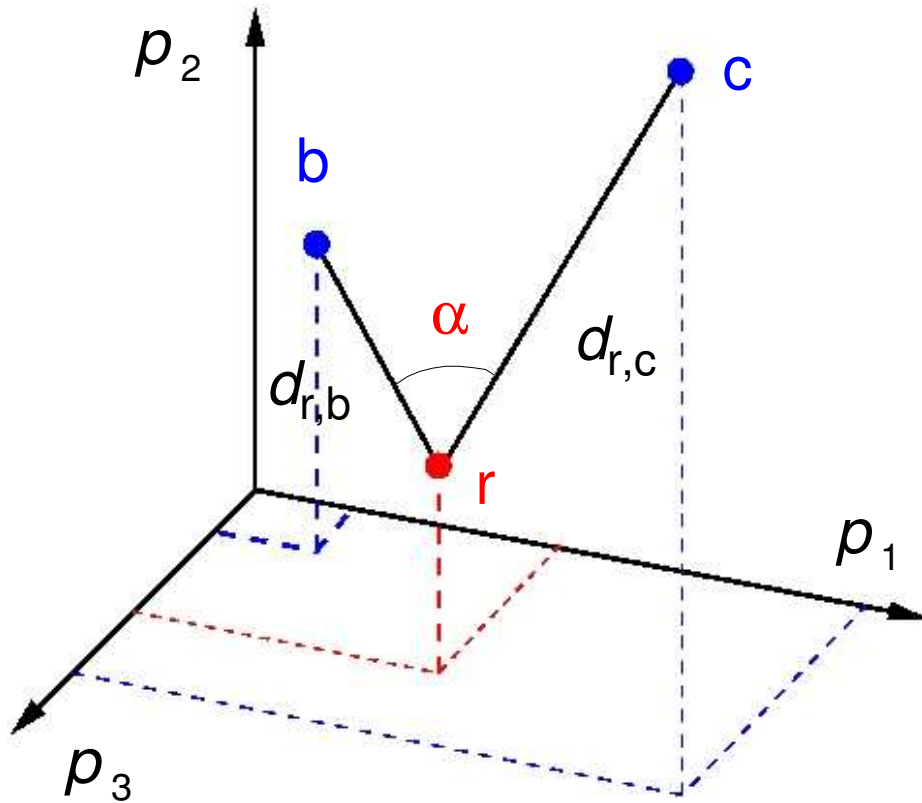


Figure-of-merit measures:

1. SNR-distance between stars according to their AP differences (*scalar separation*)
2. Angle between the local directions in which the APs vary (*vector separation*)

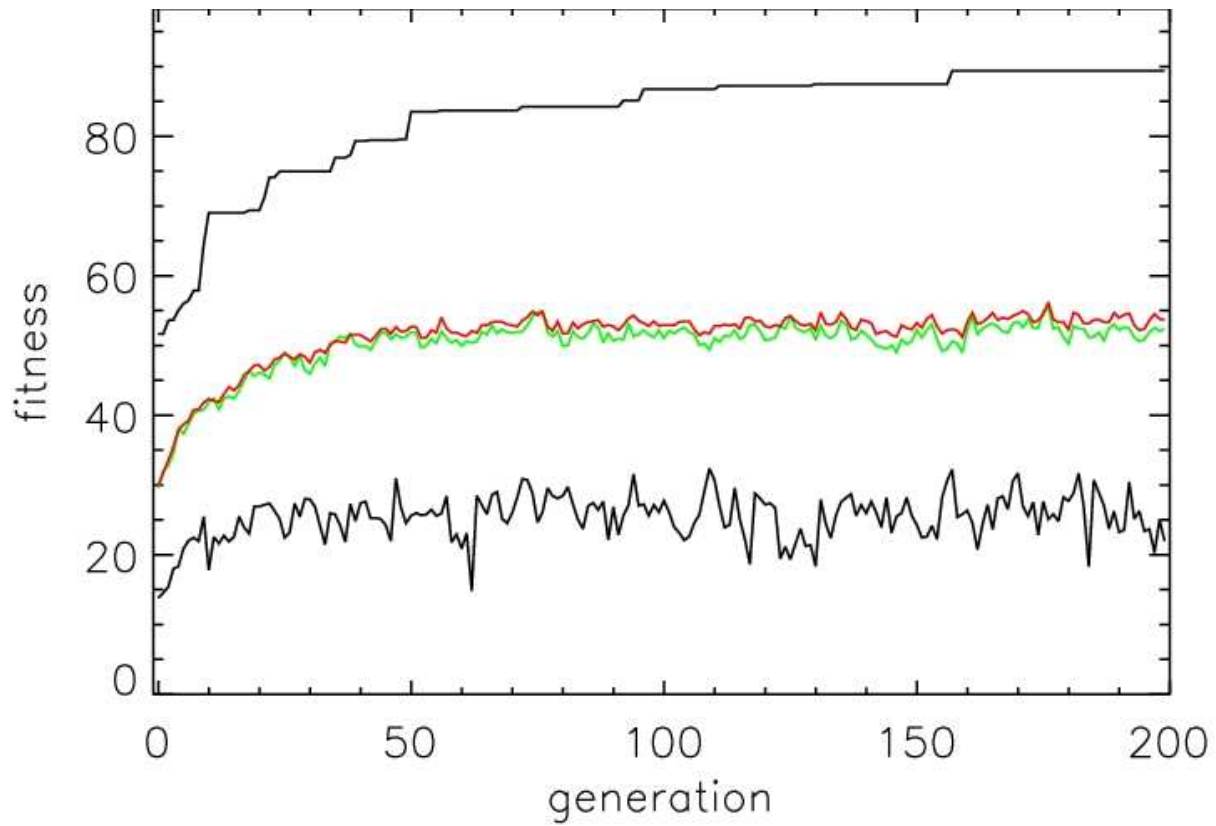
Optimal FS has:

$\alpha = 90^\circ$ for all AP

AP gradients sufficiently large

AP gradient: $\frac{d_{r,b}}{\Delta\phi_{j,r,b}}$

Fitness evolution



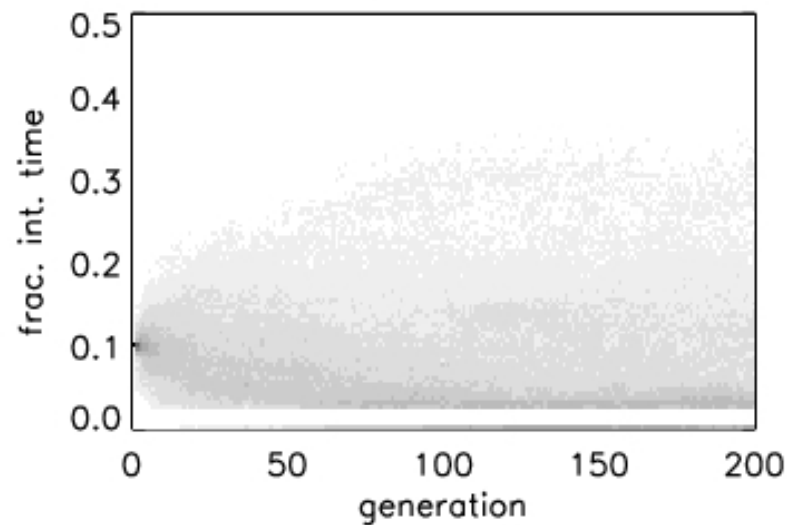
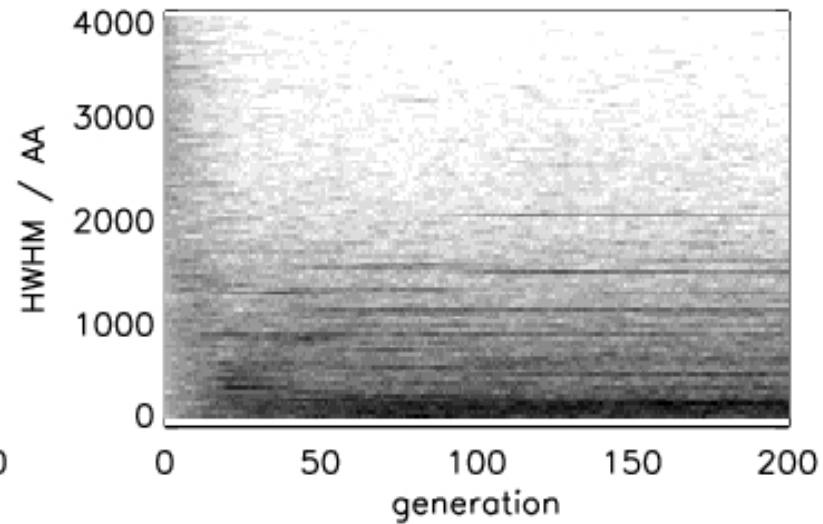
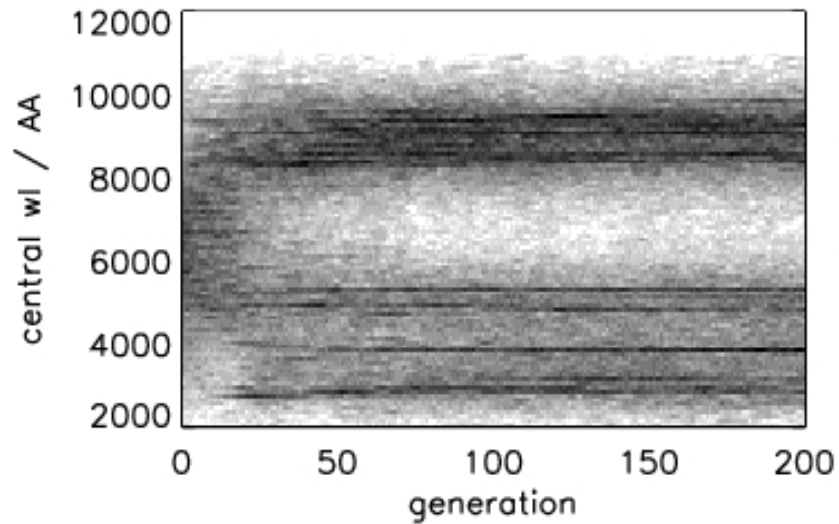
maximum fitness

mean fitness

median fitness

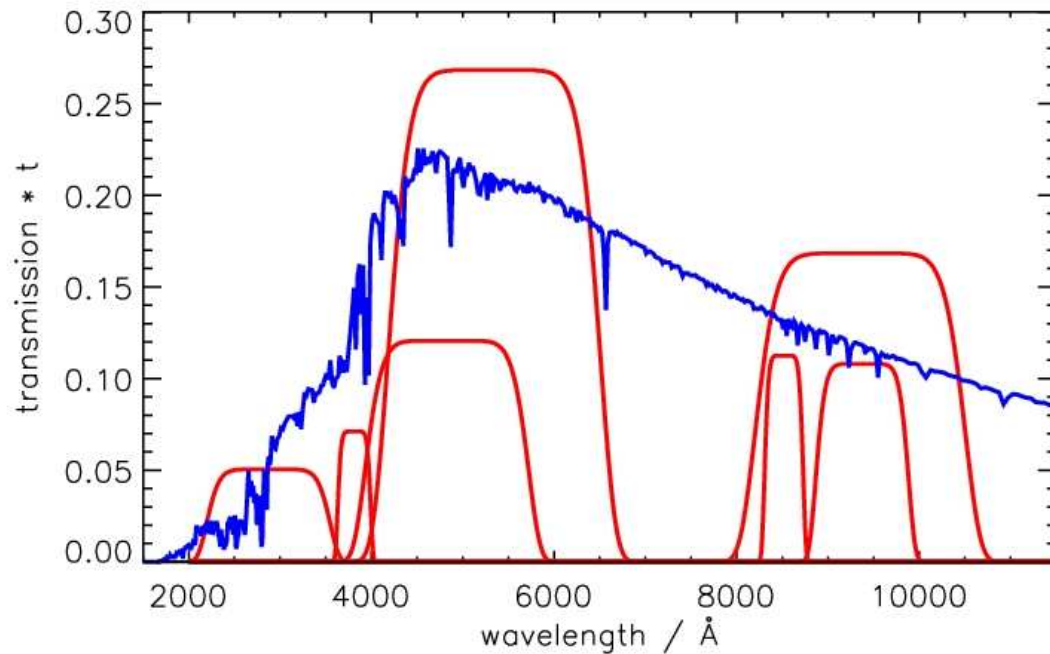
minimum fitness

Filter parameter evolution



1000 points (200 filter systems * 5 filters)
for each parameter type at each generation

Optimized MBP system

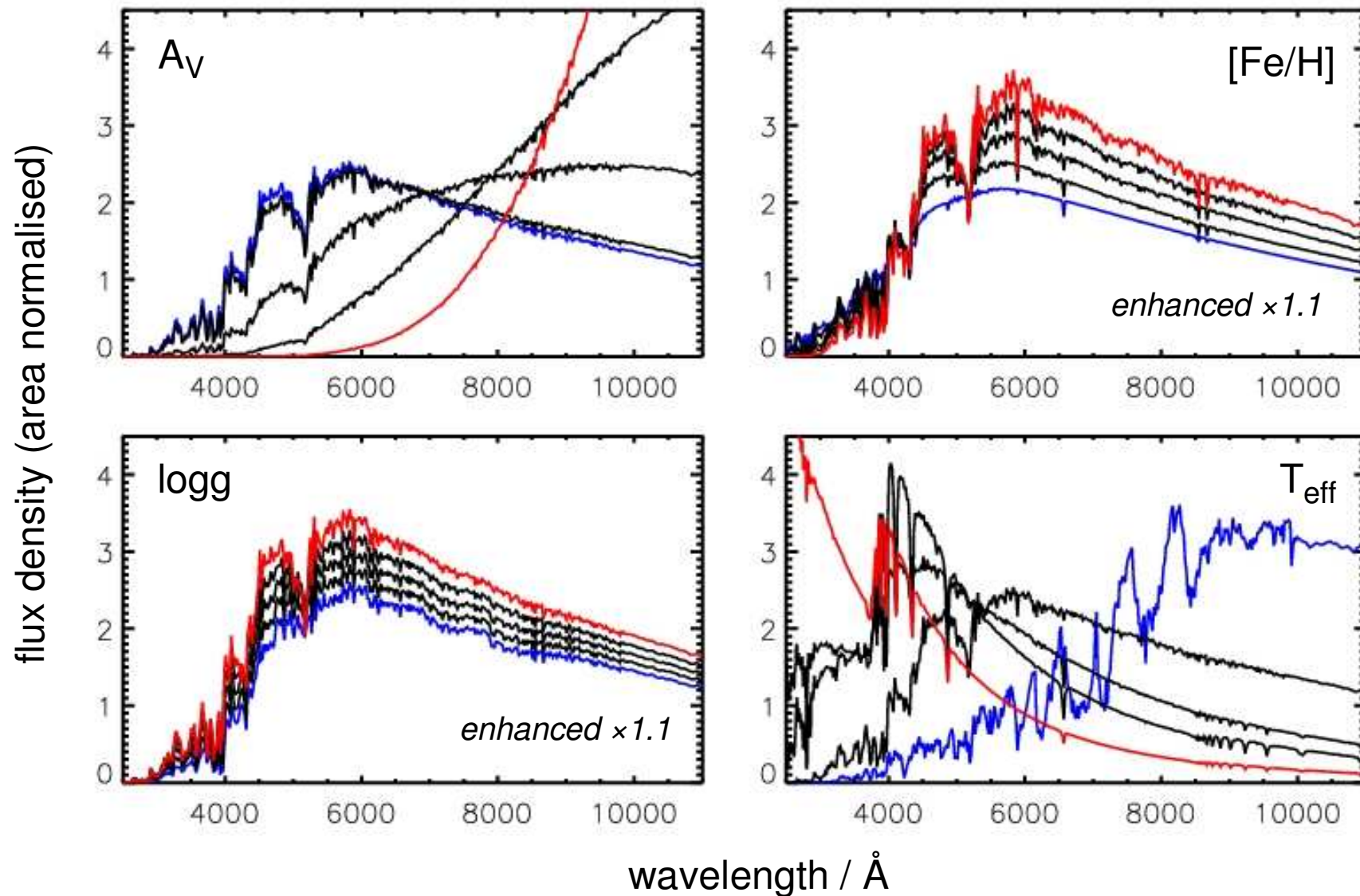


red = filter transmission
x fractional
integration time

- unintuitive tendency toward broad, overlapping filters
- performance (in terms of fitness components) similar to 1X and 2F
- self-regulation of parameters (e.g. ability to “turn off” filters)
- relationship to classification:

HFD is optimizing topology of data space with respect to APs

Stellar spectra: effect of astrophysical parameters (APs)



Future ICAP work/priorities 1

- PS optimization (1 July deadline)
 - HFD improvements
 - Brown's implementation of Lennart's FoM into UB simulator
- classification algorithms for core data processing
 - onboard detection (morphological classification)
 - selection of GIS stars
- improved classification algorithms
 - recognition of degeneracies
 - coping with weak APs
 - template mismatch problem
- implementation/development of parallax tool

Future ICAP work/priorities 2

- calibration of classification algorithms
 - empirical classifications and/or model-dependent APs?
- overall classification framework
 - overlap with Variability and Alerts tasks
- organisational
 - role with respect to other Working Groups
 - GDAAS
 - ESA data processing Announcement of Opportunity
 - manpower, commitment, funding

Topics to discuss at this meeting

- discussion of algorithms/techniques for classification
- input to GDAAS; role of DPWG
- cross-WG co-ordination
 - re-assessment/better specification of WG goals
 - classification framework
 - algorithm and expertise exchange
- potential response to AO
 - commitment, funding, distribution of tasks
- input to simulation activities