



THE WEIZMANN INSTITUTE OF SCIENCE
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE

Vision and Robotics Seminar

Room 1 ,Ziskind Building
on Thursday, Apr 14, 2016
at 12:15

Barak Zackay
Weizmann Institute of Science- Department of Particle Physics and Astrophysics

Proper astronomical image processing - Solving the problems of image co-addition
and image subtraction

Abstract:

While co-addition and subtraction of astronomical images stand at the heart of observational astronomy, the existing solutions for them lack rigorous argumentation, are not achieving maximal sensitivity and are often slow. Moreover, there is no widespread agreement on how they should be done, and often different methods are used for different scientific applications. I am going to present rigorous solutions to these problems, deriving them from the most basic statistical principles. These solutions are proved optimal, under well defined and practically acceptable assumptions, and in many cases improve substantially the performance of the most basic operations in astronomy.

For coaddition, we present a coadd image that is:

- a) sufficient for any further statistical decision or measurement on the underlying constant sky, making the entire data set redundant.
- b) improves both survey speed (by 5-20%) and effective spatial resolution of past and future astronomical surveys.
- c) improves substantially imaging through turbulence applications.
- d) much faster than many of the currently used coaddition solutions.

For subtraction, we present a subtraction image that is:

- a) optimal for transient detection under the assumption of spatially uniform noise.
- b) sufficient for any further statistical decision on the differences between the images, including the identification of cosmic rays and other image artifacts.
- c) Free of subtraction artifacts, allowing (for the first time) robust transient identification in real time, opening new avenues for scientific exploration.
- d) orders of magnitude faster than past subtraction methods.