

MultiSpectral Imaging for *E. coli* Microbial Source Tracking

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Microbial Source Tracking

- Microbial source tracking (MST) is scientific pursue to determine the sources of bacteria.
- MST is important for identifying the source bacterial contamination in water and food.

Review of New Approaches

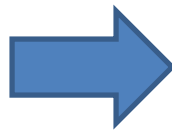
- Traditional methods
- DNA microarray analysis
- DNA sequences analysis
- Metagenomics
- Use of mass sequencing based technology to identify host specific SNP PCR primers

Optical Scattering for MST

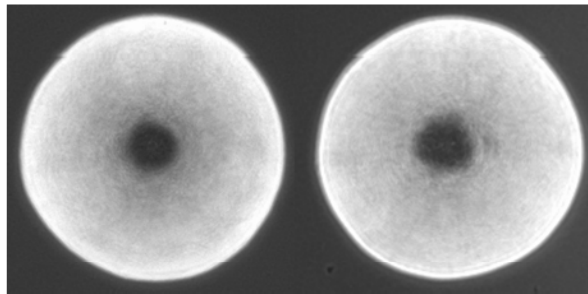
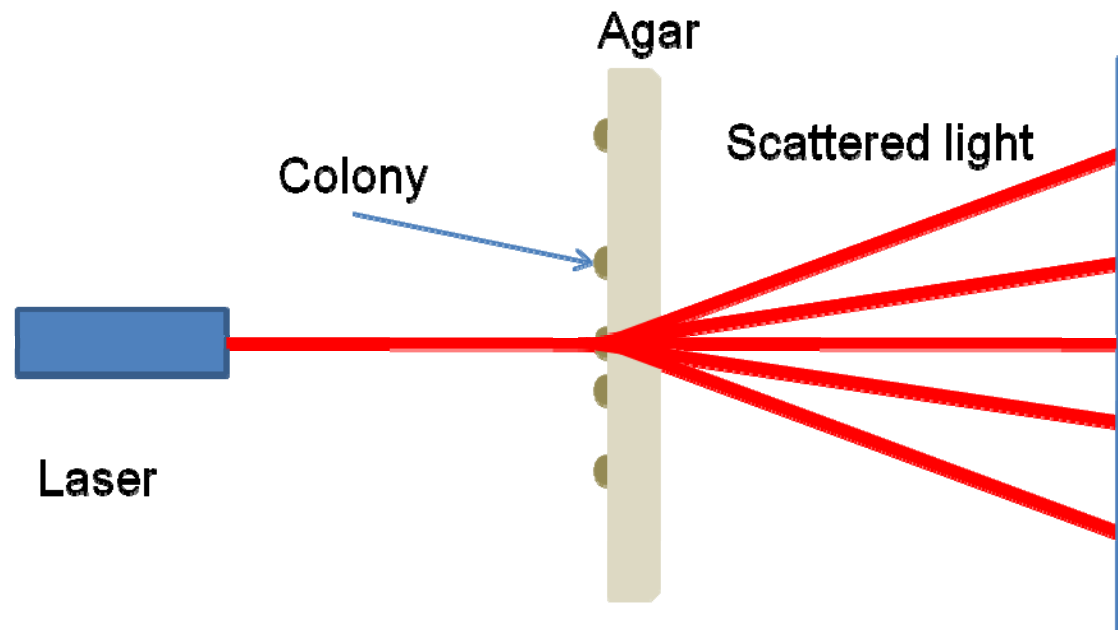
- Polarized differential light scattering for identifying bacteria above species in suspension.
- Colony based laser scattering for identification of different pathogenic bacterial species in food samples.

Bacterial Preparation

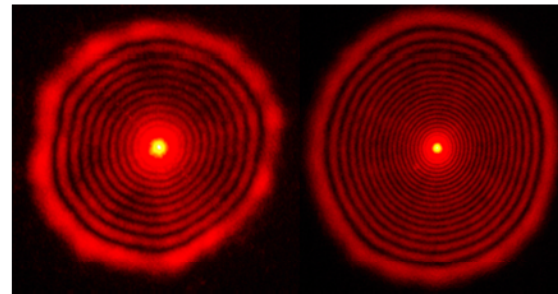
- Grow *E. coli* in broth
- Plate *E. coli* on LB agar plate
- Select colonies for laser scattering imaging



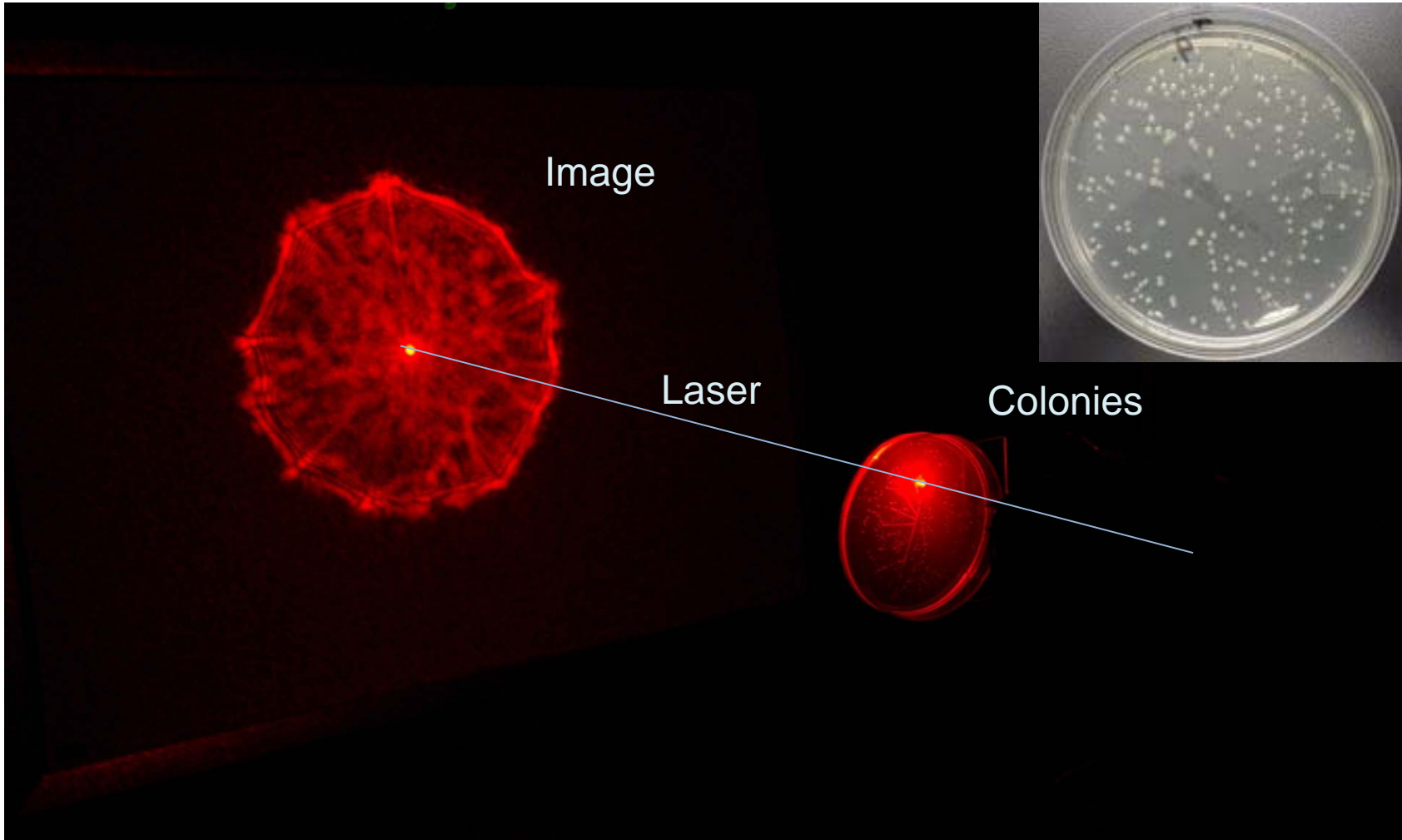
Forward Light Scattering



Microscopic Images



Scattering Images



Laser Scattering Images

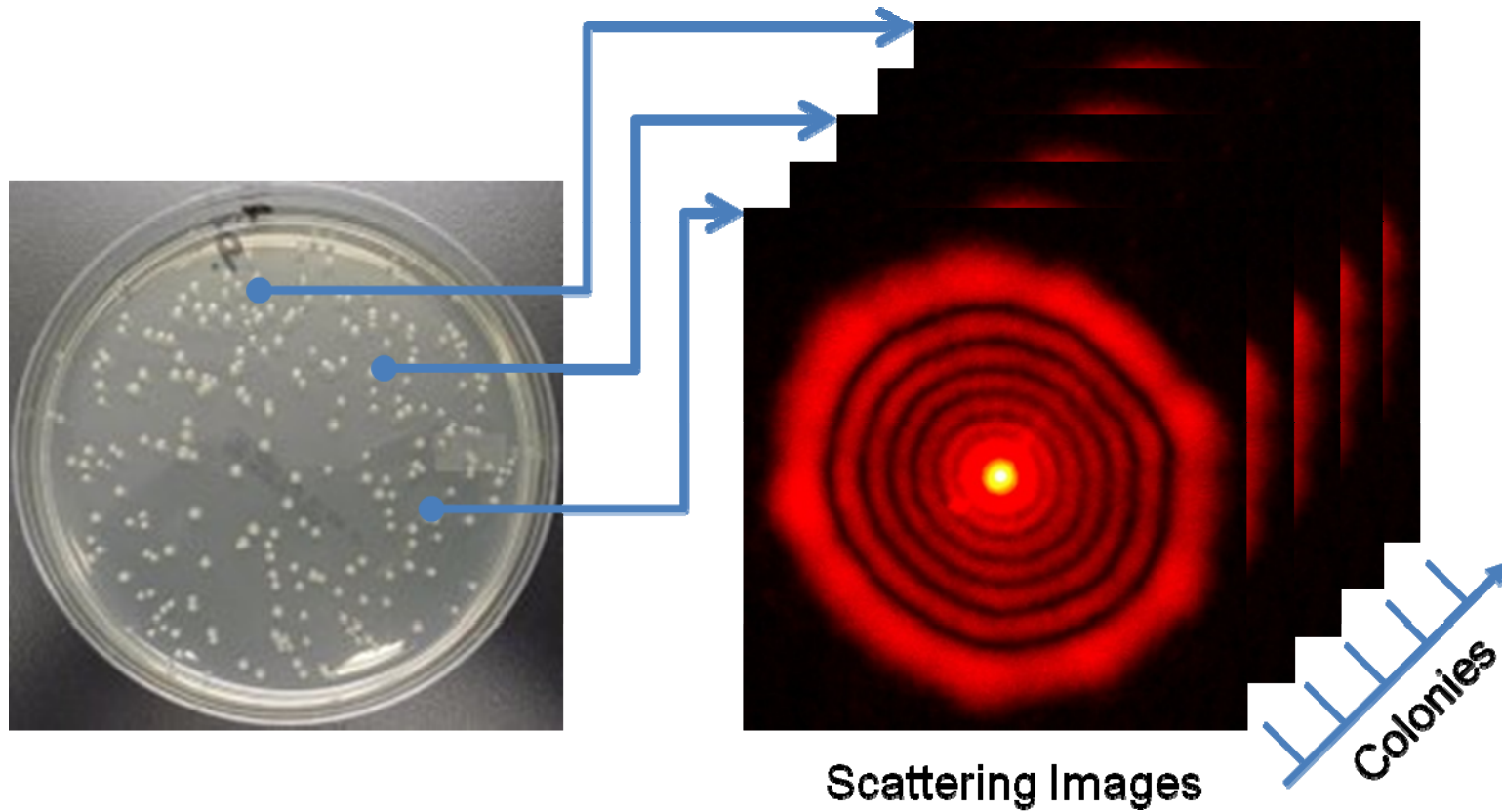
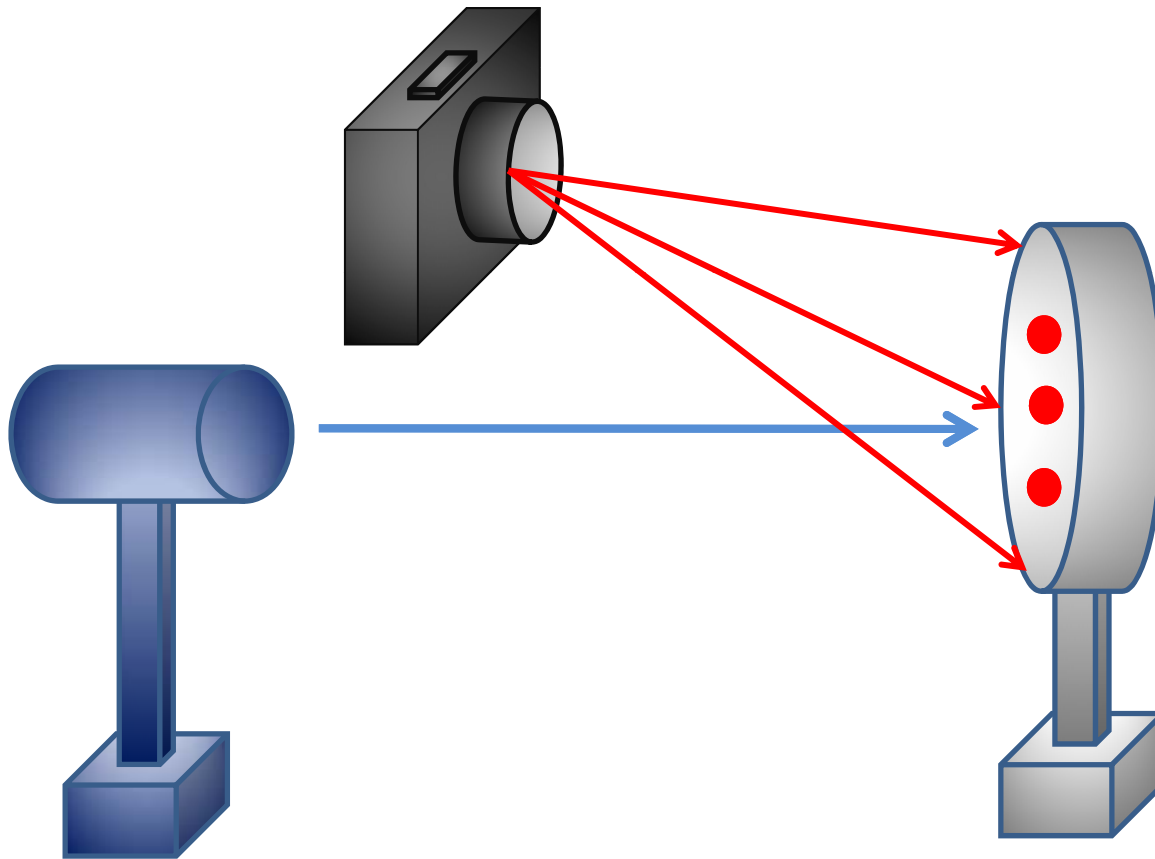


Image Acquisition Automation



Projection Transformation

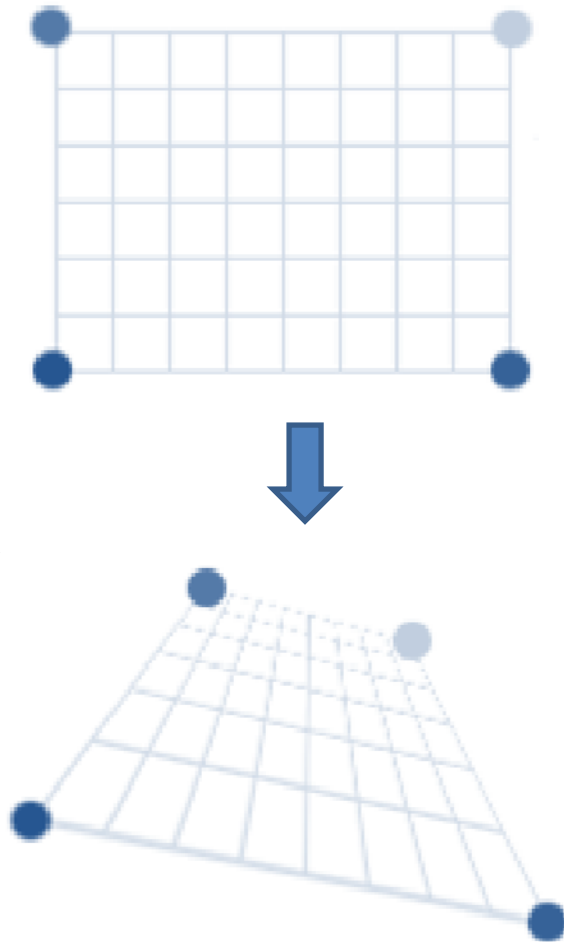


Image Acquisition Automation

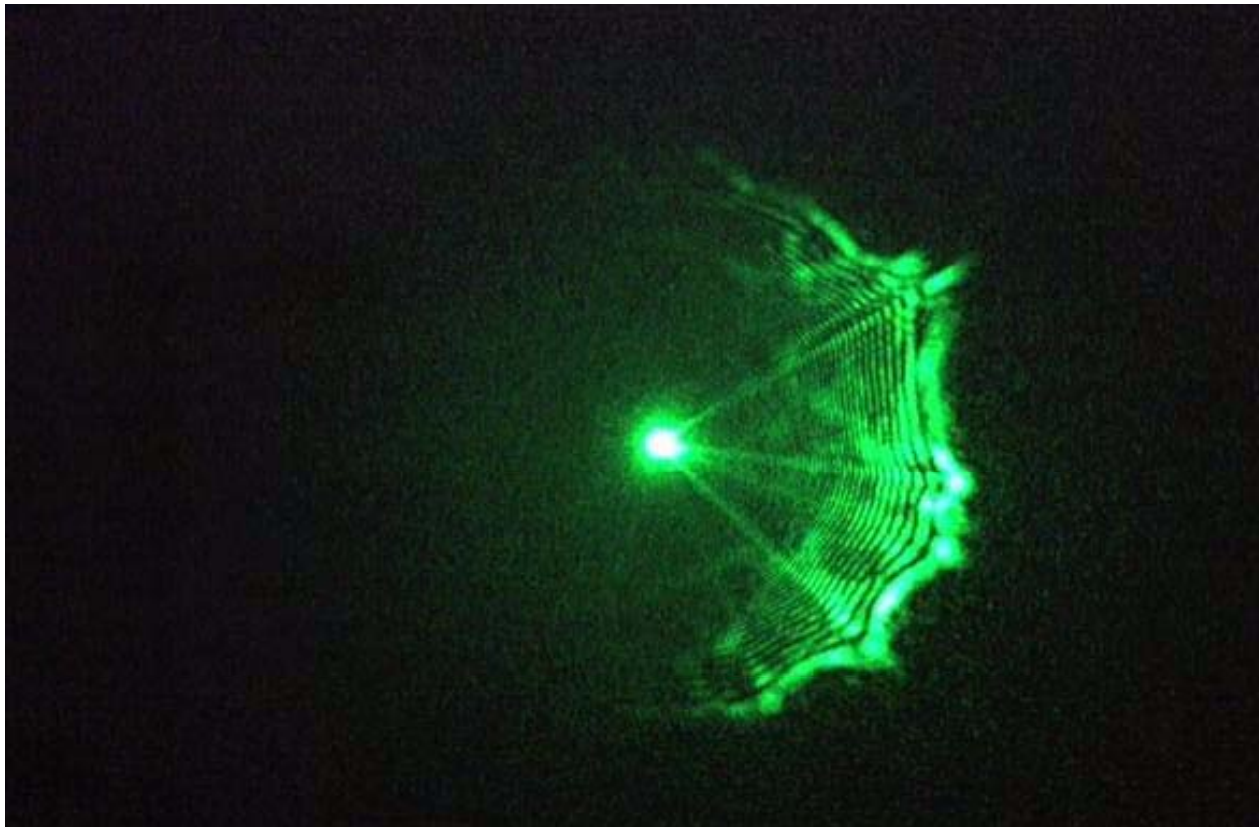
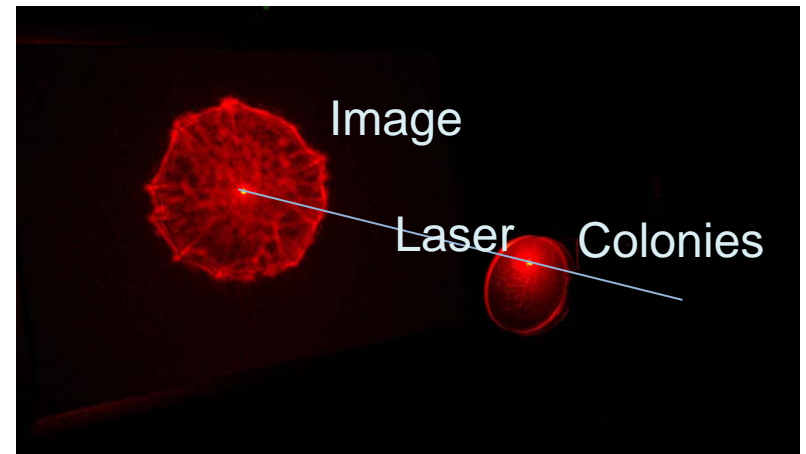
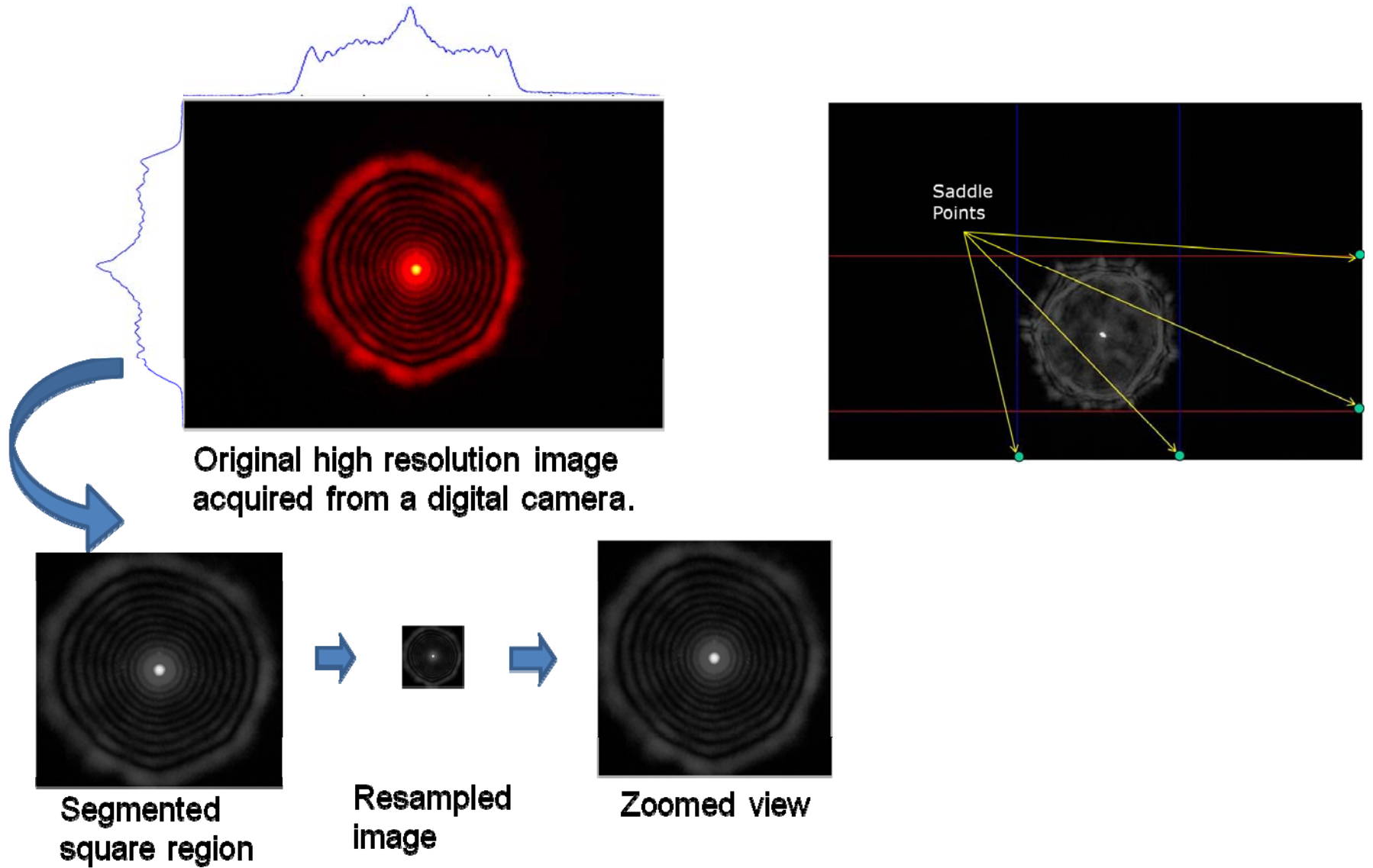
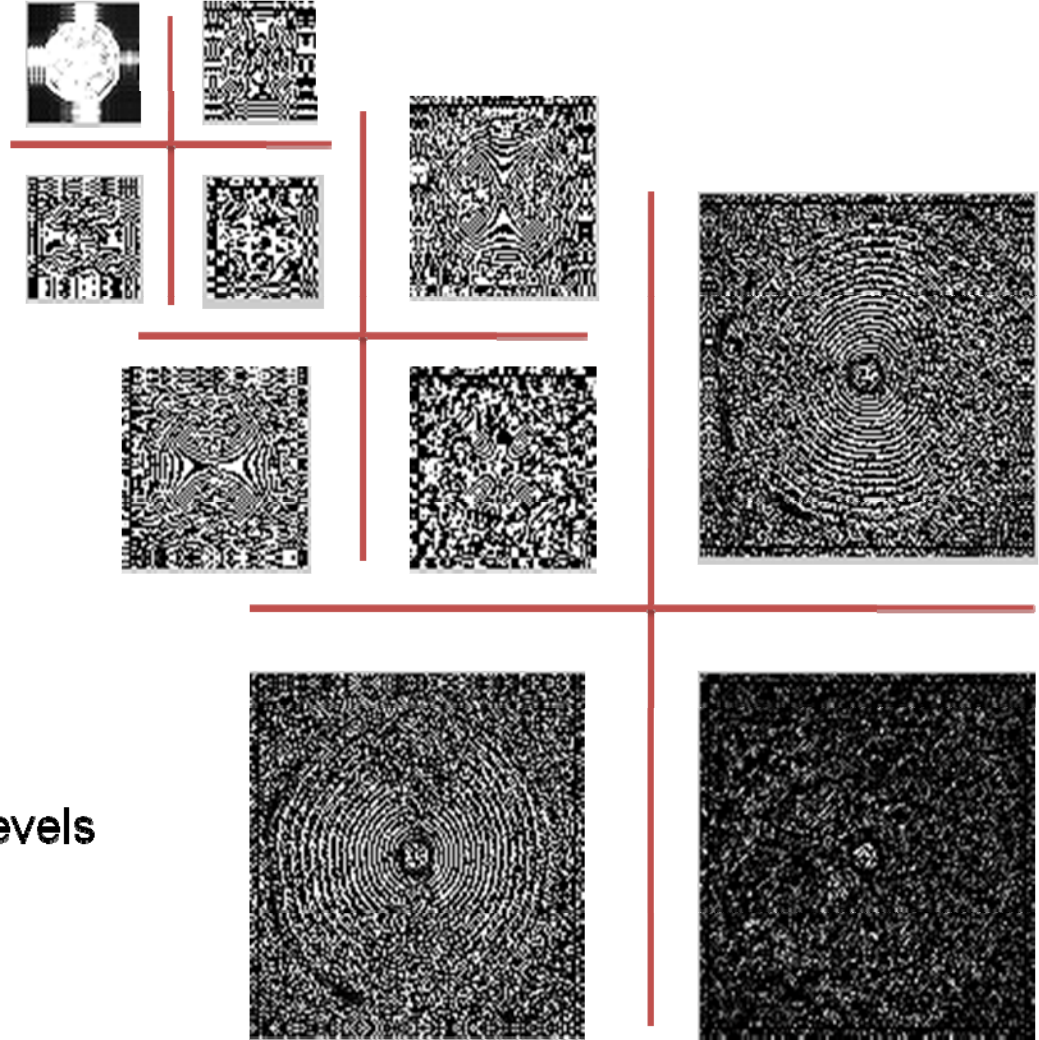
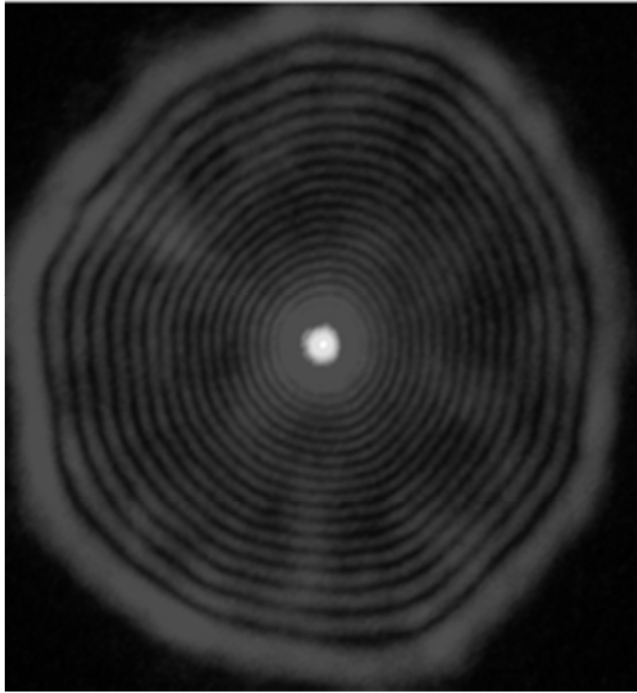


Image Preprocessing

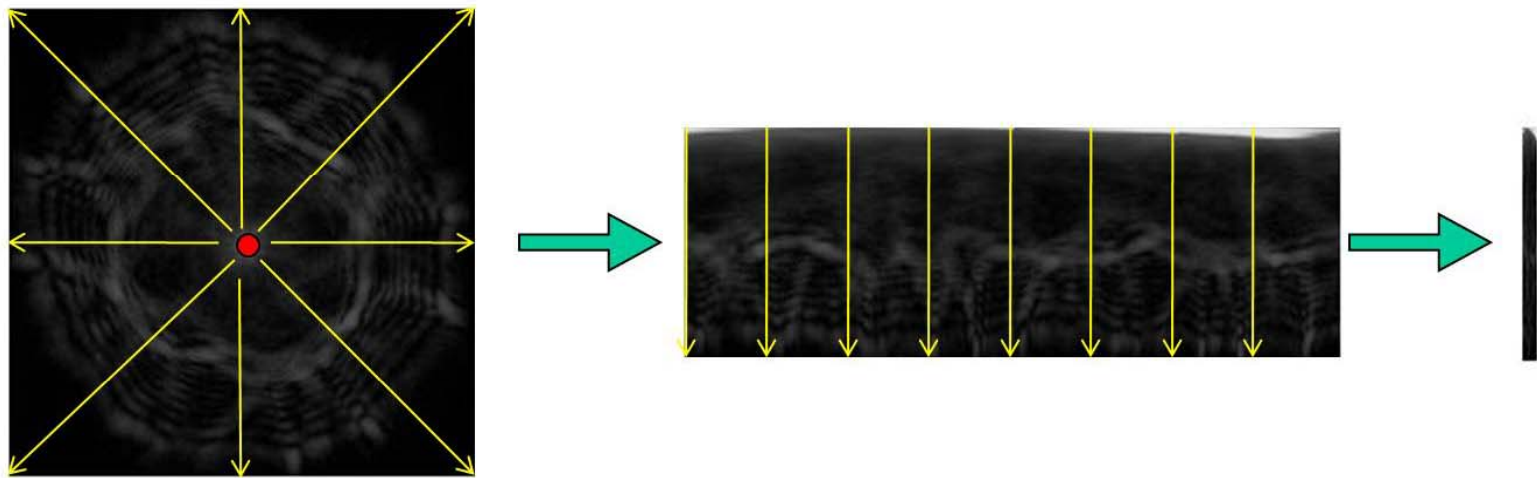


Feature Extraction



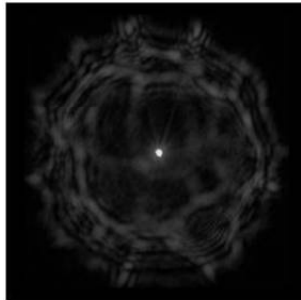
Resampled Image and three Levels
of Wavelet Components

Feature Extraction

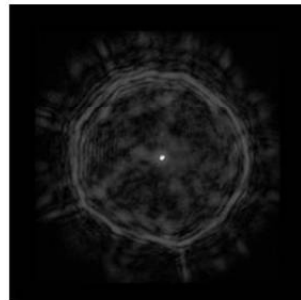


Gabor wavelets decomposition along 8 directions.

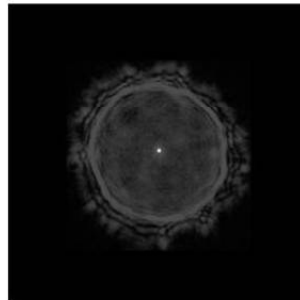
Feature Vectors



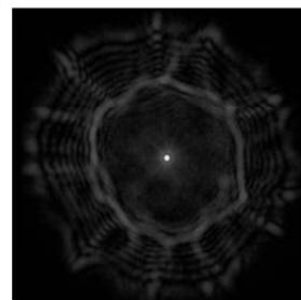
Cow B6



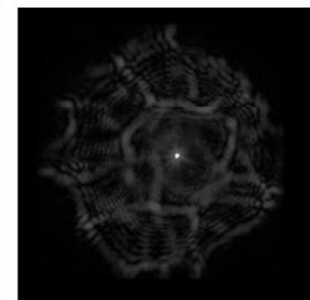
Goose B9



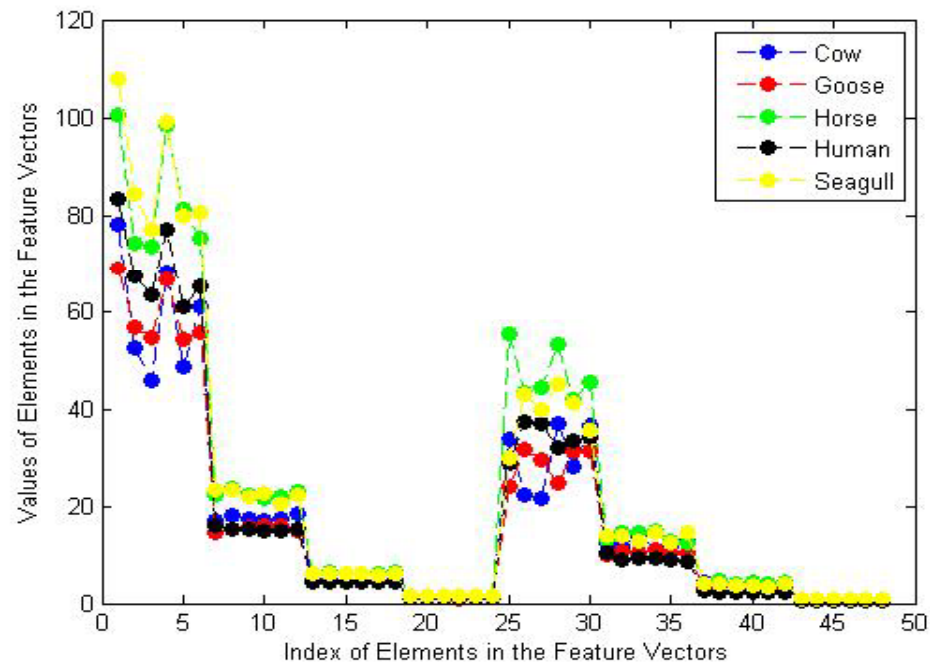
Horse E4

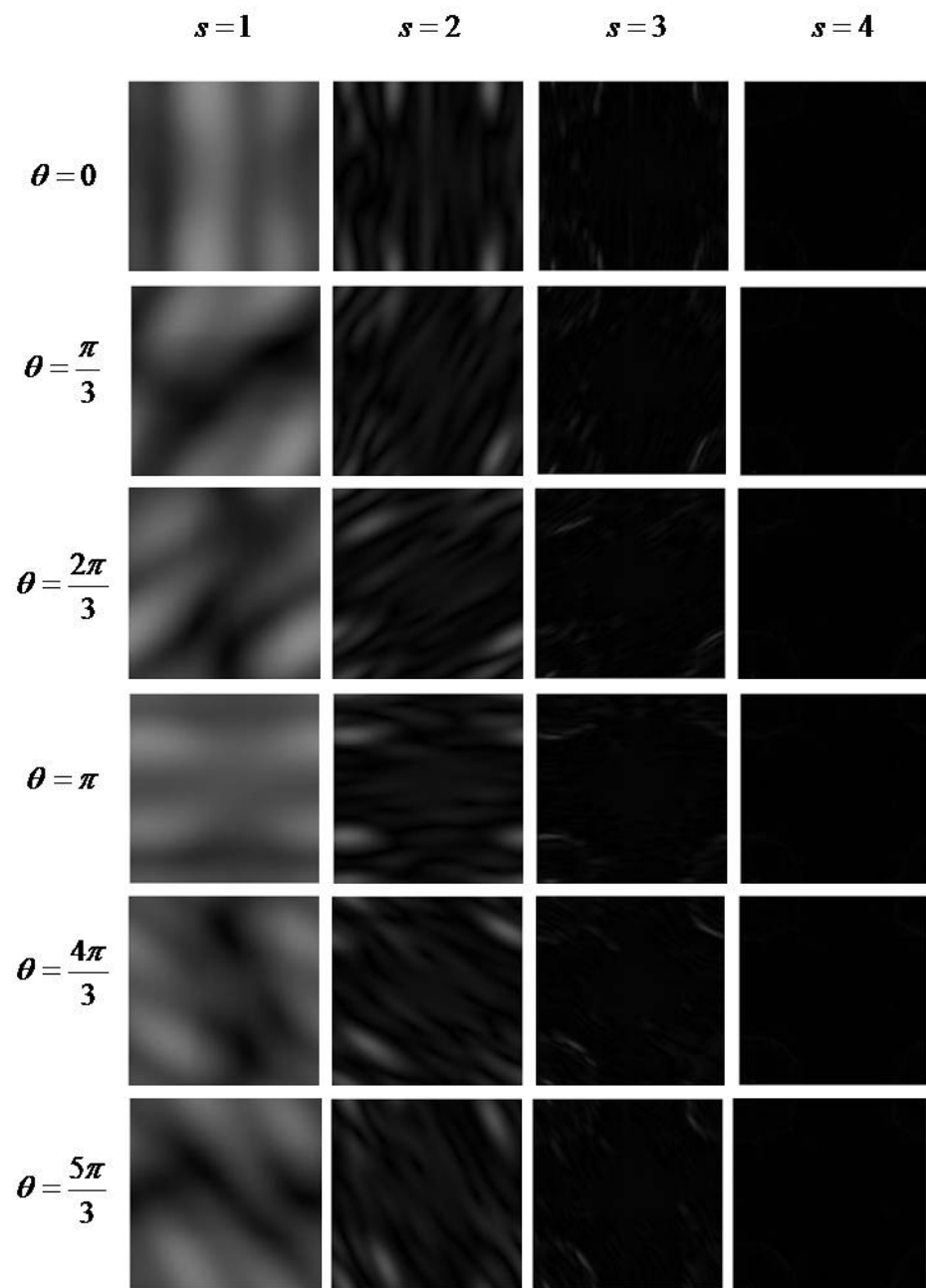


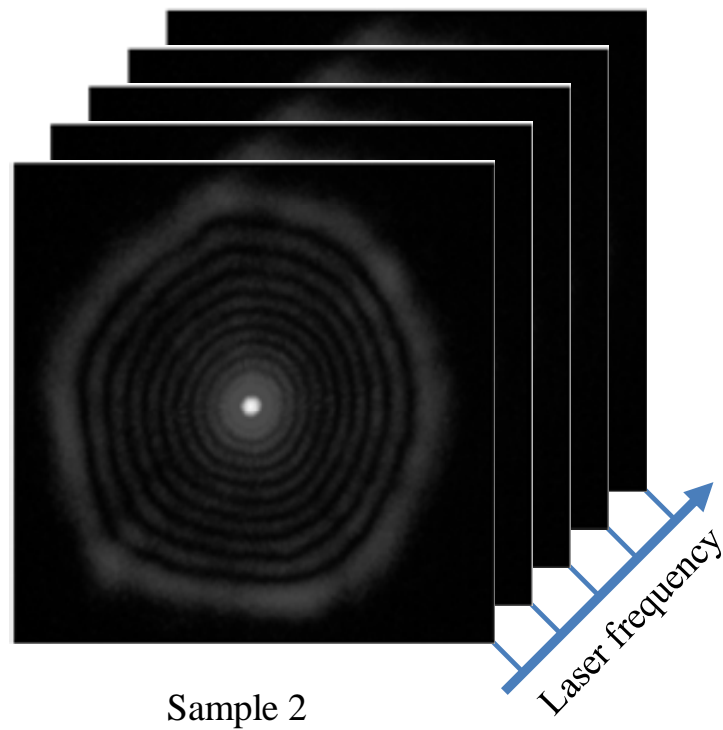
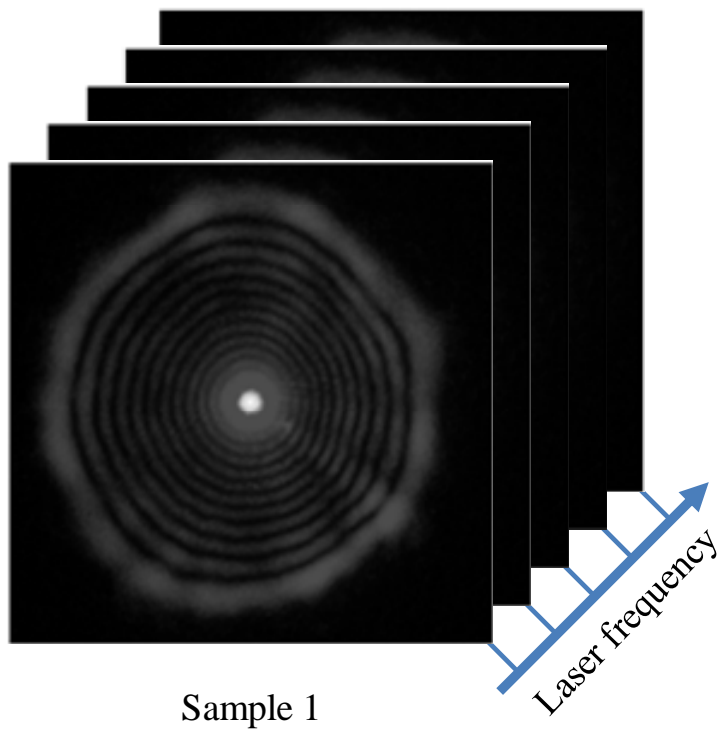
Human B4

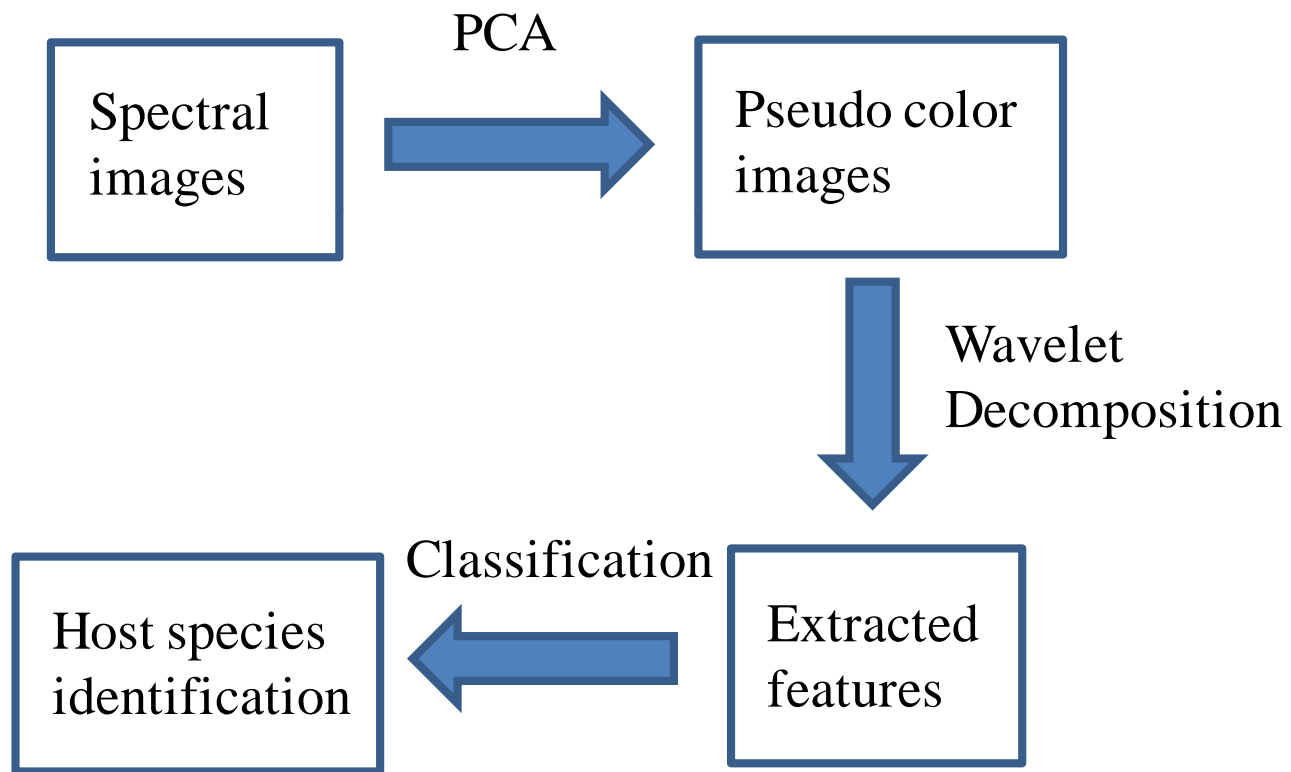


Seagull 100

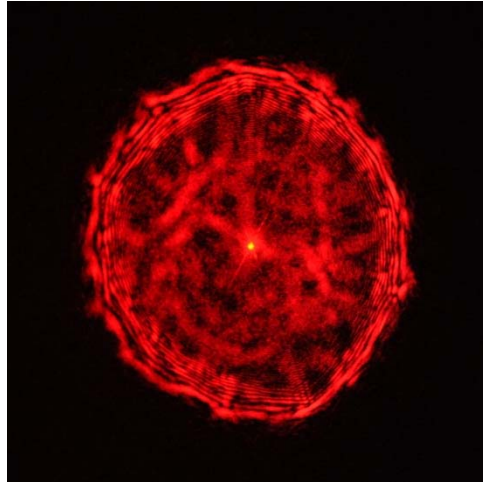




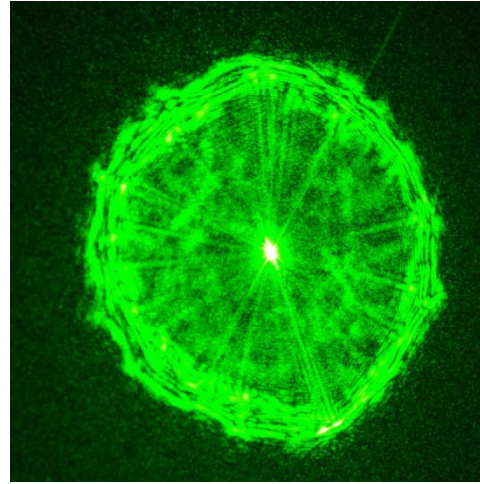




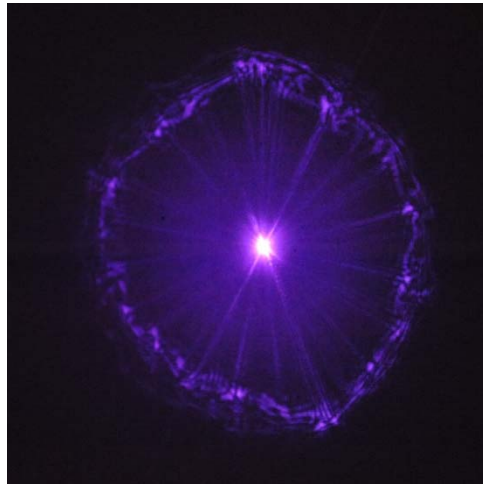
A Sample Colony of Goose



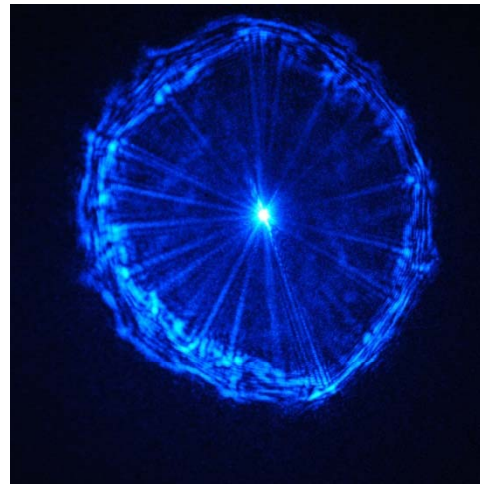
633nm



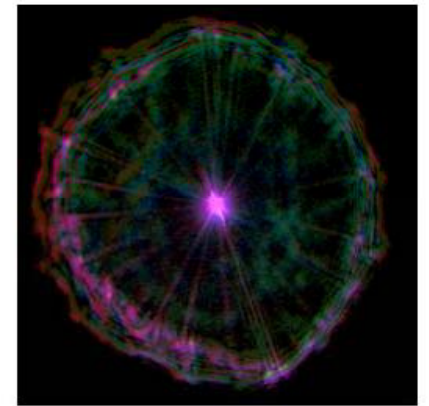
532nm



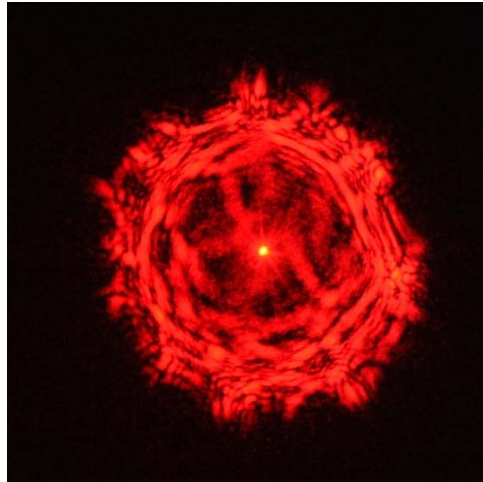
405nm



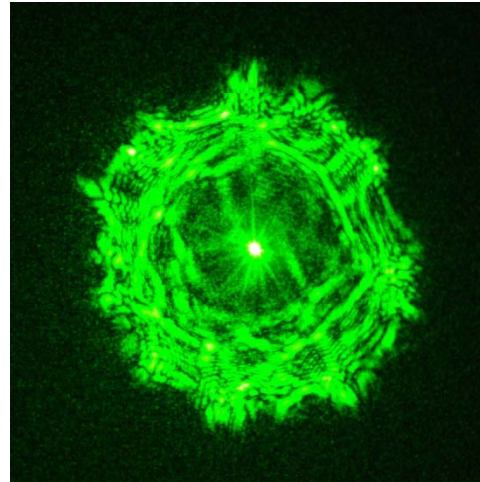
473nm



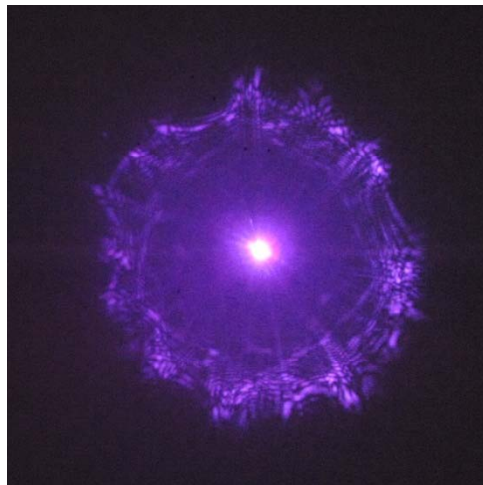
A Sample Colony of Cow



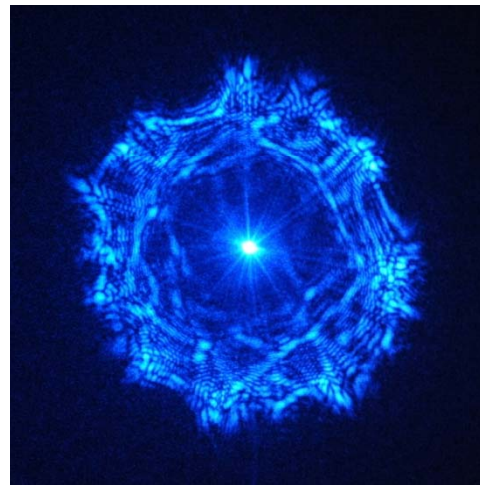
633nm



532nm



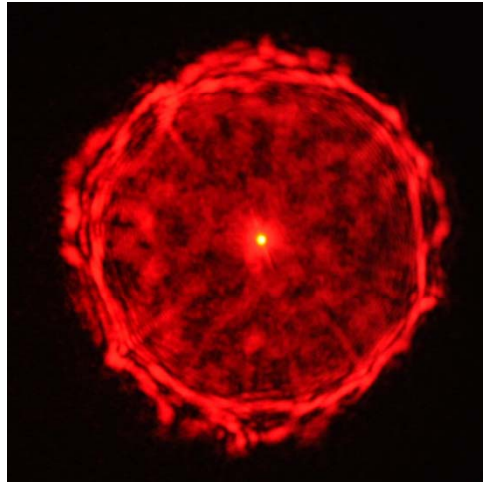
405nm



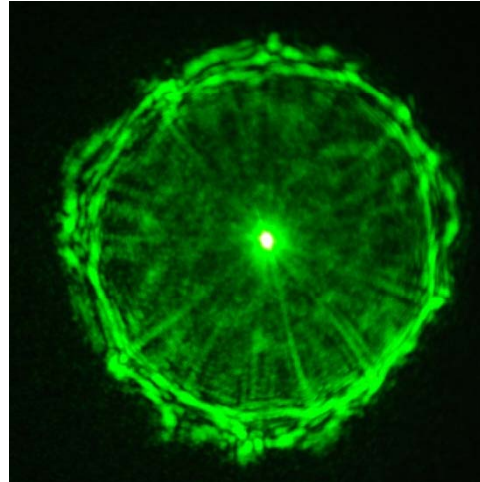
473nm



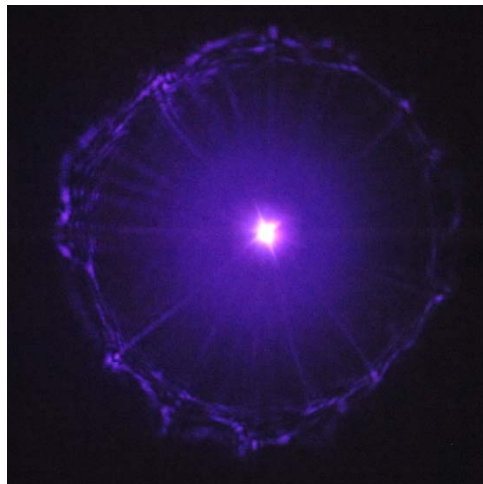
A Sample Colony of Horse



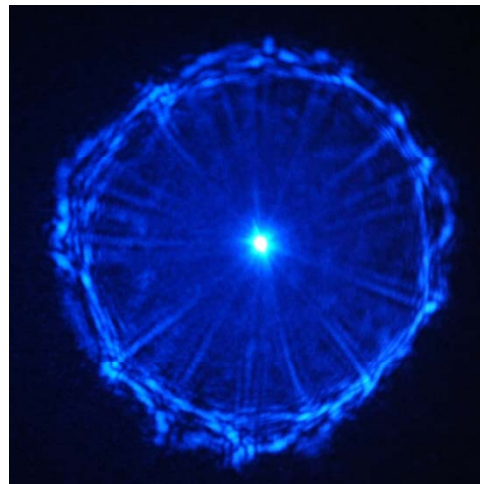
633nm



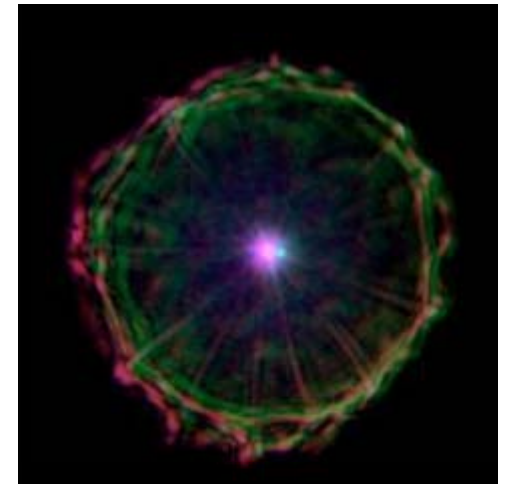
532nm



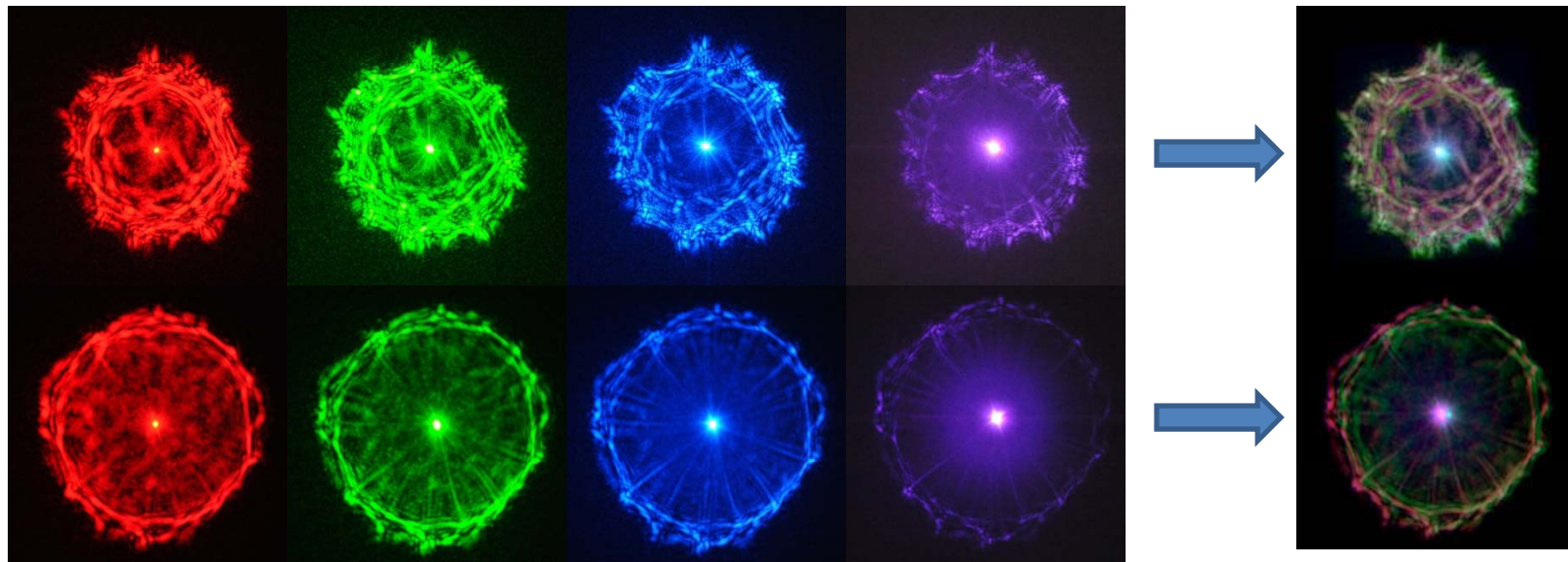
405nm



473nm



MultiSpectral Imaging Patterns



- Images taken by different lasers have different features and patterns
- Image patterns are evolving along with the laser frequencies.

Results and Discussions

Host Species	Colonies	Identified	Accuracy
Cow	20	18	85%
Goose	20	19	95%
Horse	20	19	95%

- Relatively long imaging time
 - 30 seconds for one picture
 - E. coli keep growing during image acquisition
- More image needed for reliable statistical results
- Fast image acquisition techniques

Thank You