



Output from Discussion Sessions

The discussion sessions were centered on three themes: Acquiring Useful Images, Challenges in Gaining and Managing Data from Images, and The Future of Marine Visual Imaging. The following points were raised in the break out discussions, and have been grouped into common themes:

General

- We must consider the costs of imaging – both time and money.
- Currently the industry-focus and research-focus are not aligned. How do we solve this (or do we need to)?

Defined goals

- Why are we collecting this data, and are all steps to imaging (capture, preprocessing, annotation) necessary? The answer will decide the scale of your image collection, and the equipment needed.
- Planning stages – how much data can you get out, and how much can you use? Quality, not necessarily quantity, of images is important.
- It is important to get the data to fit the questions.
- We need to design in advance, and be selective in the approach to image use.

Capturing photos

- Set up issues – differences in downward and oblique imagery, consider the application of each and which is appropriate depending on the goals.
- How to keep up with technology of imagery/cameras/AUVs?
- How to deal with using laser points in rocky or unflat substrate?
- If we want to share data, there are inconsistencies between collecting images with respect to techniques and equipment.
- Human input (time) for acquisition is decreasing, but input into processing is increasing.

Processing photos

- There is a need for software tools to process images (and metadata), with some easy and some hard problems.

- We need to find mechanisms to transcend the research and computer science domain, and to get software for processing to a commercial/end user stage.
- Many people developing processing techniques/codes are PhD students, but what happens to the code when they finish? One possibility is the continuous evolution of code through software companies.
- A significant amount of time is spent changing video into images, with further time spent sticking images together into a mosaic.
- Are there things we can learn from corrections to imagery during preprocessing that can inform our capture technique/equipment/strategy? What can we do when capturing images to reduce processing needed?

'Big data'/data management

- We have plenty of data – we are facing 'big data'.
- We can collect so much data now. Why are images increasing in volume? It is cheaper to collect them.
- Data management is a big problem.
- The metadata for images is also important.
- The sheer volume of data is a big problem – how can we secure it, gain access and share it?
- What is managing data? Storing it in a way that is retrievable.
- Database design is an art, and needs forward planning.
- What are the possibilities for data sharing between users globally? We all need to make data sharing active.
- How can we make metadata, media, and annotations tracked and accessible in a standard way?
- Databases are moving to being shared.
- There has been some reinvention of the wheel with many different databases for managing image data, which causes some frustration.
- When it comes to longevity of datasets and storage, who will pay?
- To establish a data sharing scenario, we will need a homogenization of policies, and a framework for metadata.

Standardizing Annotations

- There is a movement to standardize annotations – within projects, within institutions/organizations, and globally.
- Could we make a global database? How can we standardize our annotations so we can share data easily?
- Everyone's needs are different, so how realistic would it be to make a global effort?
- We need to tap into our collective knowledge base for identifying animals in photos – could we make a repository of the unknowns to begin with?
- One idea involves setting a baseline, with plugins for different needs.
- There is frustration with many of aspects of annotation.
- Consistency in annotation is difficult when you farm out data.

Future

- It would be great to have a decision tree for imaging – what to do when you are starting a project? Who to contact with expertise in different areas?
- We need to continue existing discussions, and open new discussions between different groups – taxonomists, ecologists, computer scientists, and engineers.
- Will we ever be happy with just using automated annotation, and removing the human element?
- We are developing more tools, so we are able to solve more problems, which is good! In particular, the development of new tools for taxonomy and processing will develop the science.
- As an end user, it is hard to consider the future of imaging as it hard to anticipate developments in technology.
- Most cameras are just in the visual spectra, so a futuristic wish list would include imaging with other optical spectra, acoustic cameras, the ability to turn different filters on and off, multi cameras for movement, and lighting improvements.
- Other items in the wish list include: something similar to fish eye cameras in order to reconstruct smaller items, the ability to capture more 3D recordings, a single stream of video that includes stills (no extraction required), and stereo cameras with automated image processing to follow moving objects.
- We need to address the challenges of recording from stationary platforms.
- In the future, imaging processing and annotation could be a partnership between computer and humans.
- Future innovations for annotation could include small portable devices with touch screen, and voice recognition to make human annotation easier.
- We need to investigate making data into a game for crowd sourcing.
- More virtual reality displays would be great – helmets or flexible computer monitors or glasses, even for use on the ship!
- In future workshops, each discussion group could get a problem (including images and metadata) to work on – this might help to focus the group.