Corelyzer: Scalable Geologic Core Visualization using OSX, Java and OpenGL

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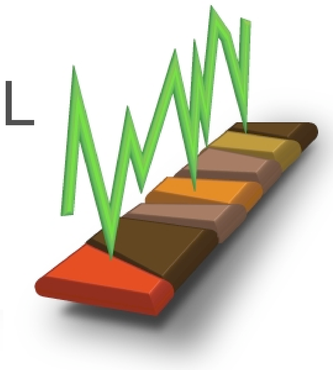


Abstract

Ice cores drilled from lake and ocean floors, continents, and ice sheets provide geoscientists with the most extensive and accurate picture of the earth's climate history. For decades, these stratigraphic records have been locked in core repositories around the world. Now, aided by modern information technologies and advanced equipment like high-resolution color line-scanners and multi-sensor data loggers, core data can be digitized to create large amounts of high-precision digital images and numerical data.

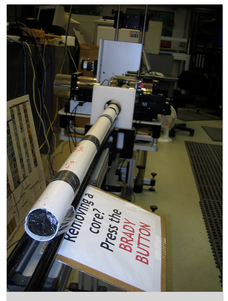
Corelyzer allows geo-scientists to collaborate over huge data visualizations in a desktop workstation using single or multiple monitors with great interactivity and scalability. The main user-interface was developed in Java with native methods for efficient rendering with the OpenGL implementation on Mac OS X. A multiple level-of-detail texture paging system is implemented inside Corelyzer that allows scientists to load and interact with thousands of meters of geological cores, for which approximately one kilometer produces 30 GB of raw imagery.

With the ability to display core sections in high resolution, Corelyzer is best viewed on tiled 30 inch Apple Cinema Displays. Corelyzer can scale to display on multiple large displays run by a single computer all the way down to the new MacBook. Future development will incorporate the use of a table of Apple displays driven by a cluster.

Lake core drilling

ANDRILL
Courtesy of Luke Rutland and National Science Foundation

Core extrusion



Multi-sensor Core Logger

Requirements

Split-core surface images are the fundamental template of sediment descriptive work. Loaded horizontally and viewed in high resolution along a sliding plane, features such as lithologic variation, macroscopic grain size variation, bioturbation intensity, chemical composition and micropaleontology are easier for geo-scientists to interpret and annotate.

Main requirements are:

- Display large amount of imagery (approximate 30GB per hole)
- Numerical data registered to the imagery
- Easy navigation
- Configurable for multi-screen display systems
- Annotations for discussion and description
- Extensible

Corelyzer can make use of high-resolution tiled LCD display to give geo-scientists a large-scale perspective, helpful in processing and comparing high-resolution digital line-scan images of cores measuring up to hundreds of feet long. Using LCD tiled-displays will overcome the difficulty of correct color perception about cores under poor lighting condition in drilling sites. To display such huge amount of imagery data, a level-of-detail texture paging scheme is developed. Images are first spliced into small blocks in different levels. Depending on the scientists' region of interest, Corelyzer will dynamically switch to the proper detail level and load the corresponded image blocks. With this approach, a user can browse gigabytes of core images and compare them side-by-side with real split cores to make observing details feasible.

One fourth of lacustrine core repository

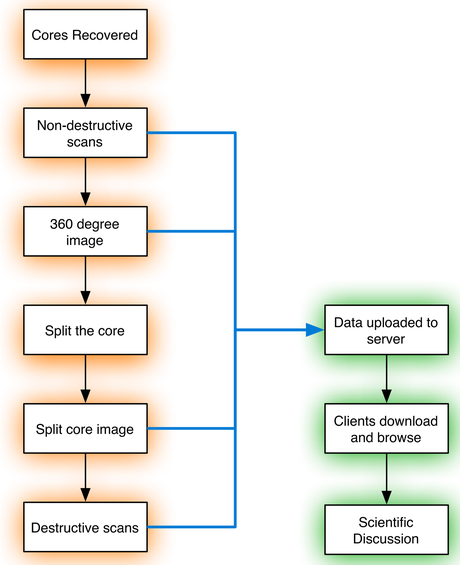
JOIDES Resolution, US IODP ship
Courtesy of IODP

Current and Future Work

In order to allow all interested parties can leverage the functions that Corelyzer provides, a plugin framework is embedded inside Corelyzer. With this framework, plugins can be developed to fit Corelyzer into different projects' workflow and requirements easily. Examples of extensibility by individual organizations include: heterogeneous database access, image analysis and Persistent Multi-user Online Collaborative Scientific Visualization (PMOCSV).

In October 2006, Corelyzer will be deployed at the ANDRILL project's McMurdo expedition station. ANDRILL is the newest geological drilling program to recover stratigraphic records from the Antarctic region.

To satisfy the ANDRILL program requirement, a collaboration plugin and server are developed. Scientists can work on either tiled-display workstation or just their laptop to browse the latest drilling results. The multi-logger sensor data and high-resolution images will be publish to the collaboration server then notify all the Corelyzer collaboration plugin clients. Scientists can also input annotations and chat on core data interested. These records will be stored persistently and can be used to facilitate discussion among science teams not only during the drilling phase but also post-drilling research and publications.



Integration of
the PMOCSV Corelyzer Plugin (green) with
the ANDRILL workflow (red)

References

CoreWall
www.corewall.org
Electronic Visualization Laboratory, University of Illinois at Chicago
www.evl.uic.edu
JOI Alliance: Joint Oceanographic Institutions
www.joiscience.org
Integrated Ocean Drilling Program
iodp.tamu.edu
CHRONOS
www.chronos.org
ANDRILL: Antarctic Drilling Program
www.andrill.org
LacCore: U.S. National Lacustrine Core Repository at the University of Minnesota
lrc.geo.umn.edu/LacCore/laccore.html

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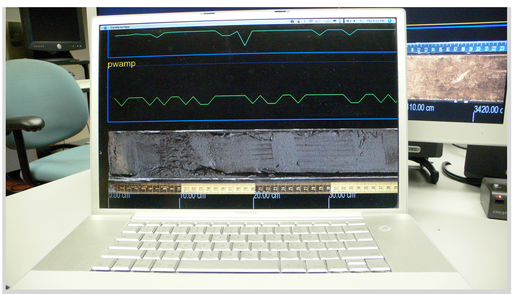
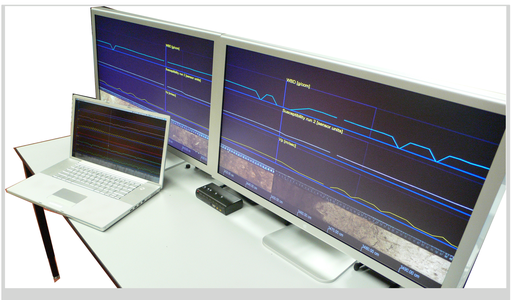
Corelyzer logo is designed by Julieta Aguilera



Corelyzer running on a 17" Powerbook



Corelyzer running on 17" Powerbook and PowerMac G5 with dual 30" Apple Cinema Displays