Exciting New Developments in the Java Advanced Imaging API and JAI-Image I/O Tools Package

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Get up to date on JAI

Learn about the current status of and future plans for Java Advanced Imaging and JAI-Image I/O Tools

Agenda

What is Java Advanced Imaging?

Presented if sufficient interest (8 slides)

Current state of JAI

Future plans for JAI

Discussion

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What is Java Advanced Imaging?

JAI-Image I/O Tools Overview

- A separate package set
  - com.sun.media.jai.imageio
- Reader and writer plug-ins
  - BMP, GIF (writer only), JPEG (lossy and lossless), JPEG-LS, JPEG 2000, PNG, PNM, Raw, TIFF, WBMP
- Stream plug-ins
  - New I/O FileChannel-based input and output
  - Segmented input
- JAI operation plug-ins
  - ImageRead and ImageWrite

What is Java Advanced Imaging?

JAI Overview

- An optional package
  - javax.media.jai
- Built on Java2D.
- An API for advanced image processing on the Java platform.
- A flexible, extensible framework for creating image processing operators.
- A network-aware, scalable, high-performance, cross-platform imaging library.

What is Java Advanced Imaging?

Architecture

- Image objects connect to form graphs.
- Graph nodes may store or compute pixels.
- Results are obtained by *pulling* data.
- Images are *tiled*.
- Intermediate results may be cached.
- Multithreading used for scalability, prefetch.
- Deferred execution combined with tiling guarantee "just-in-time, just-what-needed".

What is Java Advanced Imaging?

Java Programming Model: Push and Immediate Mode

	Push Model	Immediate Mode Image Buffer Model
Major Interfaces/ Classes	• Image • ImageProducer • ImageConsumer • ImageObserver (JDK 1.0.x, 1.1.x)	• BufferedImage • Raster • BufferedImageOp • RasterOp (Java™ 2D API)
Pros	• Processing driven by image availability (e.g. over network) • Images processed incrementally	• Simplest programming interface • Commonly used model
Cons	• Requires transfer (but not processing) of complete images • More complex programming interface	• Requires memory allocation of complete images • Requires processing of complete images

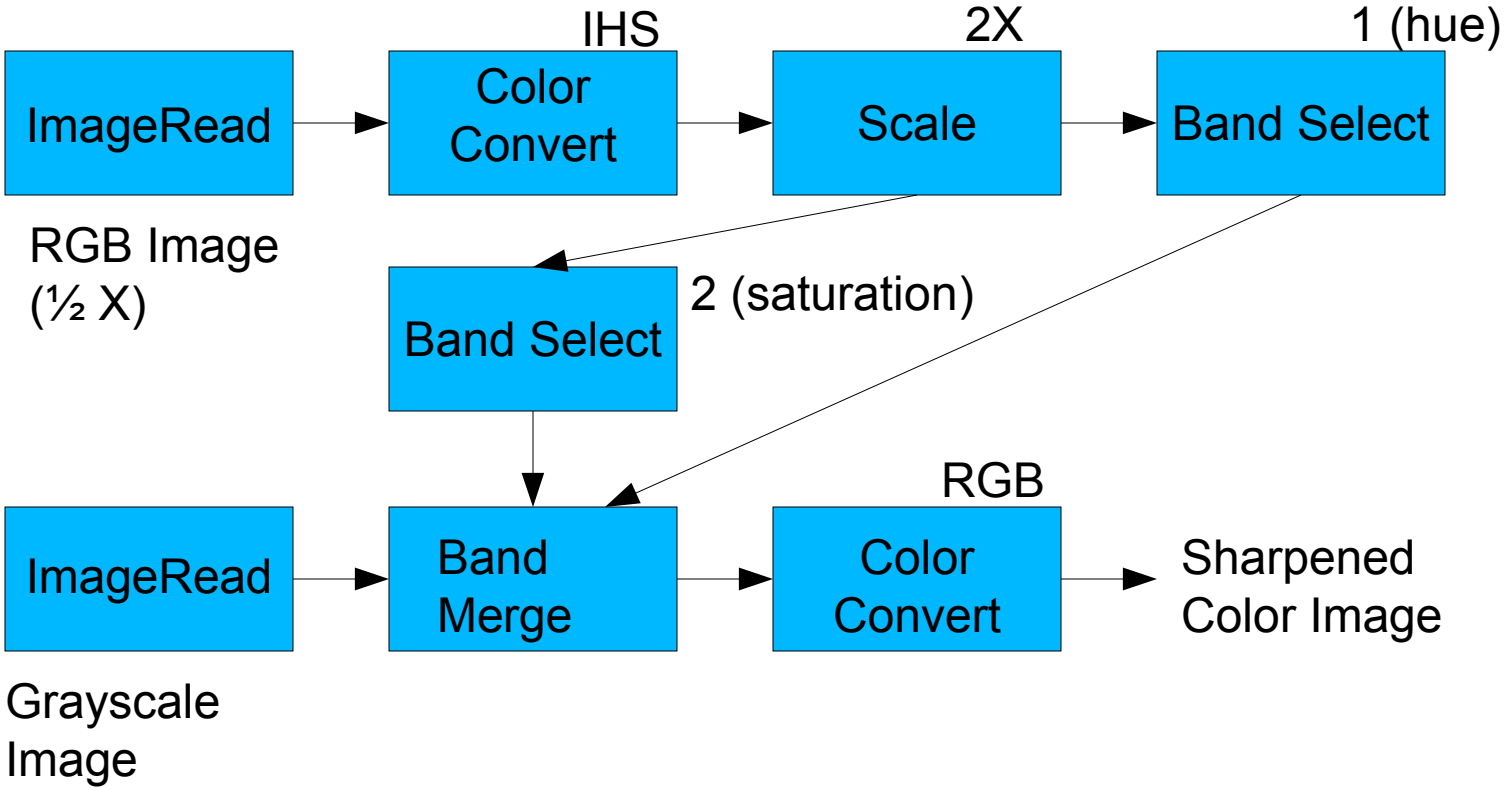
What is Java Advanced Imaging?

Java Programming Model: Immediate Mode and Pull

	Immediate Mode Image Buffer Model	Pull Model
Major Interfaces/ Classes	• BufferedImage • Raster • BufferedImageOp • RasterOp (Java™ 2D API)	• RenderableImage • RenderableImageOp (Java 2D API) • RenderedOp • RenderableOp • Tiled Image (Java Advanced Imaging API)
Pros	• Simplest programming interface • Commonly used model	• Stores/processes only required data • Allows lazy evaluation
Cons	• Requires memory allocation of complete images • Requires processing of complete images	• More complex programming interface • More complex implementation

What is Java Advanced Imaging?

JAI Operation Graph: Image Sharpening



What is Java Advanced Imaging?

JAI Code Sample: Image Sharpening

```
RenderedOp gray, rgb, ihs, ihsScaled, hue, sat,
           ihsSharp, rgbSharp;
// Dimensions of "intensity are 2X those of "rgb".
gray = JAI.create("ImageRead", "Gray.tif");
rgb = JAI.create("ImageRead", "RGB.tif");
IHSColorSpace ihsCS = IHSColorSpace.getInstance();
// Create ColorModel "ihsCM" from ihsCS (omitted)
ihs = JAI.create("ColorConvert", rgb, ihsCM);
AffineTransform xform =
    AffineTransform.getScaleInstance(2.0, 2.0);
ihsScaled = JAI.create("Affine", ihs, xform);
hue = JAI.create("BandSelect", ihsScaled, new int[] {1});
sat = JAI.create("BandSelect", ihsScaled, new int[] {2});
ihsSharp = JAI.create("BandMerge", intensity, hue, sat);
// Create ColorModel "rgbCM" from sRGB ColorSpace (omitted)
rgbSharp = JAI.create("ColorConvert", ihsSharp, rgbCM);
```

What is Java Advanced Imaging?

Other Aspects of JAI

- Not really a desktop API: no display components.
- Resolution-independent imaging supported via the renderable layer.
- Server-agnostic network imaging API with RMI server provided.
- Metadata handled innately via image property mechanism.
- Image collection processing support.
- Pluggable operation framework with over 100 intrinsic operations, some natively accelerated.

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Current State of JAI

History on java.sun.com

- JAI 1.0 released at JavaOne 1999
  - Very mature product: 6 years in the field
- JAI-Image I/O Tools 1.0 released July 2003
- JAI 1.1.2_01 released September 2004
  - Final java.sun.com-only release
- JAI-Image I/O Tools 1.0_01 released Nov. 2004
  - Final java.sun.com-only release
- 950 mailing list subscribers
  - As of 15 April 2005

Current State of JAI

Benefits of java.net

- Community
  - Project membership
- Development
  - Source code hosted via CVS
- Communication
  - Mailing lists and Forums
- Planning
  - Issue tracking
    - Defects
    - New Features

Current State of JAI

Transition to java.net

- JAI and JAI-Image I/O on java.net in Feb. 2005
  - Source code now available
  - Development happens in the open
- JAI container project "jai"
  - JAI package code in "jai-core" sub-project
  - JAI demo code in "jai-demos" sub-project
- Image I/O container project "imageio"
  - Container for all image I/O projects
  - Includes "jai-imageio" container project
    - JAI-Image I/O package code in "jai-imageio-core" sub-project
    - JAI-Image I/O demo code in "jai-imageio-demos" sub-project

Current State of JAI

Releases since java.net transition

- JAI 1.1.3-alpha
  - Released May 2005
  - Bug fixes
  - 64-bit support for Solaris-sparcv9, Solaris-AMD64, and Linux-AMD64
- JAI Image I/O Tools 1.1-alpha
  - Released May 2005
  - Bug fixes
  - 64-bit support for Solaris-sparcv9, Solaris-AMD64, and Linux-AMD64

Current State of JAI

Project Attributes

- Container Projects
  - jai, imageio, jai-imageio
  - Mailing lists
    - announce, interest: pertinent to all contained projects
    - cvs, issues: for container web pages only
  - Issue tracker: container web pages only
- "Leaf" Projects
  - jai-core, jai-demos, jai-imageio, jai-imageio-demos
  - Mailing lists: cvs, issues only
  - Issue tracker for actual code

Current State of JAI

Roles

- Relevant roles are "Observer" and "Developer"
  - "Content Developer" for web pages only
- "Observer" role
  - Read-only access to project resources
  - Members should request this role first
  - Transition to "Developer" role may come later
- "Developer" role
  - Read-write access to project resources
  - Must submit some amount of good code first
  - Granted by consensus of Developers & Project Owners

Current State of JAI

Members and JCAs

- Number of project members
  - jai: 36
  - jai-core: 38
  - jai-demos: 21
  - jai-imageio: 13
  - jai-imageio-core: 24
  - Jai-imageio-demos: 17
  - Membership in container projects not very useful
- Number of Joint Copyright Agreements (JCAs)
  - JAI: 5
  - JAI-Image I/O: 4

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Future Plans for JAI

Objectives

- Community Building
- General Objectives
- Development Objectives
  - Maintenance
  - New Features

Future Plans for JAI

Community Building

- Increase project membership
  - More Observers
- Increase project member participation
  - Encourage code contribution
    - Joint Copyright Agreement submission
    - Patch submission
  - Encourage filing of Enhancement issues
- Increase project member responsibility
  - "Graduate" contributing Observers to Developer
  - Share project leadership with Developers

Future Plans for JAI

General Objectives

- Weekly builds
- WebStart support
- Documentation?
  - Extensive effort required for complete update to the programmer's guide
  - Alternatives
    - More limited “getting started” guide
    - Wiki

Future Plans for JAI

Development: Maintenance

- Complete current release cycle
  - JAI 1.1.3-beta and 1.1.3-fcs
  - JAI-Image I/O Tools 1.1-beta and 1.1-fcs
- Continue to support current branch
  - Compatibility with current API
  - Bug fixes
  - Native support
    - 64-bit Windows
  - In CVS trunk

Future Plans for JAI

Development: New Features

- Initiate feature release cycle
  - JAI 1.2 or 2.0?
  - JAI-Image I/O Tools 1.2 or 2.0?
- Develop new features
  - Might break compatibility
  - Might include new features at the API level
  - In CVS branch off trunk

Future Plans for JAI

Which New Features?

- Community-driven
  - Use the Issue Trackers!
  - Initiate forum/mailing list discussions!
- JAI-Image I/O Tools
  - JBIG and JBIG2 plug-ins
- JAI
  - General
    - Image progress listener, native code use listener, nearest neighbor color quantization
  - Image analysis
    - Chain codes, template matching, edge detection

Summary

Java Advanced Imaging and JAI-Image I/O Tools:

- provide extensive image processing capability on the Java platform;
- are mature products used by a diverse set of imaging applications;
- are supported as before with additional advantage of source code being available;
- have a future which will be directed by the developer community.

For More Information

Join the Community!

- JAI java.net community
  - https://jai.dev.java.net
    - https://jai-core.dev.java.net
    - https://jai-demos.dev.java.net
- Image I/O java.net community
  - https://imageio.dev.java.net
    - https://jai-imageio.dev.java.net
      - https://jai-imageio-core.dev.java.net
      - https://jai-imageio-demos.dev.java.net
- JAI home page
  - http://java.sun.com/products/java-media/jai/

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