TECHNOFROLICS™
integrating art & science

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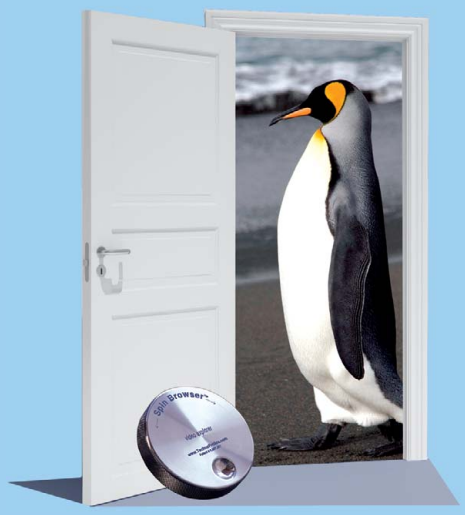
FrameGlide™ video explorer with Spin Browser™ dial

(Abbreviated "FG & SB" below)

Enabling Unique Interactive Experiences



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Trademark
"FrameGlide" and *"Spin Browser"* are TechnoFrolics trademarks.

Patent
The core FrameGlide & Spin Browser technology is covered by TechnoFrolics Patent #6,807,367.

Below we (and our clients) discuss what makes the experience of using the FrameGlide video explorer with Spin Browser dial so special.

We hope you find it both interesting and informative.

David Durlach and the rest of the TechnoFrolics Team

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Museums, Aquariums & Zoos, Universities, Fortune 500 Companies, Libraries, Sports Arenas

(A small subset of installations/clients)

Arizona Science Center
New England Aquarium
Tufts University
Farmington Library
Spirit of Ford
Boston Children's Museum
COSI Columbus
AstraZeneca Pharmaceuticals
Museum of Science, Boston
W5-WhoWhatWhereWhenWhy, Ireland
Huffman Prairie Flying Field Interpretive Center
National Maritime Museum, UK
The EcoTarium
Bradbury Science Museum
National Mississippi River Museum & Aquarium
ERBE Elektromedizin GmbH
Monterey Bay Aquarium
America West Arena
The Newseum
Agrium / Pacific Group Display

National Atomic Museum
California Science Center
Space Science Institute
MIT
Caterpillar, Inc.
MOSI - Museum of Science and Industry
Children's Discovery Museum
National Great Rivers Museum
Indiana State Museum
Maryland Science Center
Health Exploration Station
Nevada Test Site Historical Foundation
OMSI - Oregon Museum of Science and Industry
New York Hall of Science
Richland Academy
North Carolina Museum of Life and Science
Montshire Museum of Science
Clifford Wagner Science Interactives
Science World, Quebec
The Ironbridge Gorge Museums, UK

User Interface Is Self-Explanatory

From 10 year-old video game aces, to 70 year-old retired ballet dancers, users understand what to do with virtually no written directions.

This is in stark contrast to many, indeed most, other technologies.

"It is very intuitive. It's easy to use. The experience is unique and compelling."

Stephen Brand, Spirit of Ford Museum, Ford Motor Company

"The [FG & SB] functioning is immediately clear and captivating to a group of 7 year olds, yet it allows the careful, detailed examination of animal behavior that engages the interest of professionally trained biologists […]."

Alexander Goldowsky, Director of Programs and Exhibits, EcoTarium

Highly Engaging Experience

It is not uncommon for clients, prior to experiencing the FG & SB system themselves and seeing their audience's delight, to assume its ability to engage and stimulate is comparable to conventional touchscreen kiosks or button-activated DVD loops.

This view is understandable, but wrong.

Regardless of the subject matter, navigating touchscreen menus or pressing buttons to start video clips are not particularly engaging tasks. In stark contrast, dynamically examining the world through a lens of expanded or contracted time that you control, is mesmerizing.

Using the FG & SB technology is more like exploring a clear night sky with a telescope, than it is like using a conventional video display. It has that level of magic.

The experience is particularly wonderful and immersive when exploring dynamic processes, point-of-view journeys, and other richly complex visual imagery.

"To say the [FG & SB] is a hit is an understatement! The children (and adults) love it. It is in constant use."

Beverly Papai, Director, Farmington Community Library

"Needless to say, our [FG & SB] station is one of the most popular attractions on our Nuclear Weapons Exhibit and is still running trouble free."

Omar Juveland, Lead Designer, the Bradbury Science Museum, Los Alamos National Laboratory

All staff who have played on it so far finds it really cool. One person said this is the best exhibit we have in our new batch! It truly is a great product. So intuitive and easy to use.

Dave Conley, VP of Exhibits, MOSI (Museum of Science & Industry)

Visitors Connect Directly To Subject Matter

The software optimizations and physical design of FG & SB exhibits combine to:

- Make visitors feel they control the action in the scene.
- Make the technology fade into the background, and put the visitor directly in contact with the subject matter.
- Transform the visitor-video interaction from a passive viewing experience into a "visual laboratory", in which the user can focus on elements of most interest to them, notice behaviors and make connections, and in general, act as an engaged scientist and explorer.

"The TechnoFrolics ... [FG & SB] enables a distinctly personal approach for visitors, offering them a completely new way of experiencing an underwater habitat. The interactive format introduces visitors to aquatic life on an individual level. […]

Key features that support this visitor experience are:

- The extremely high-level of temporal perusal smoothness and image quality.[1]
- The imperceptible latency (time delay) between dial movement and scene evolution, providing the experience of instant, continuous control over the flow of content. For High-Def (HD) and live capture in particular, we are aware of nothing comparable.
- The enormous "dynamic range" in the temporal domain, allowing exploration of content at virtually any speed - from stop-frame to over 1,000,000 times the normal rate.
- The vast amounts of content - up to hundreds of hours and tens of terabytes - that can be stored and smoothly explored.

We found that the [system] boasts an average visitor dwell time of over two minutes, which is remarkably high even in the competitive realm of interactives. […]

The technology never interferes with the visitors' exploration but only enhances it. […the FG & SB] makes visible things that even a diver cannot see while in the water.

I can't imagine a better method […] to capture our audience's interest in learning about the importance of the world's water resources."

Jerry R. Schubel, Ph.D., President Emeritus, New England Aquarium

Extraordinary Reliability

TechnoFrolics' FG & SB system has a proven track record of outstanding dependability. The visitor interface is extremely rugged, with the dials lasting for years with no service required. And the software (the more complex element, and the large majority of the system's development effort and value) is similarly robust. With over 100 installations in the field dating back to 1999, we can state this as a fact.

We are committed to ensuring that when visitors come to your museum, they are engaged, delighted and educated, not frustrated and disappointed by an "Out of Service" sign.

Unmatched Warranty & Post-Sales Support

In our typical project scenarios, we are the point of contact for any FG & SB support issues indefinitely into the future. In addition to our generous 5 year parts and labor warranty, we typically archive all FG & SB content at TechnoFrolics for the duration of the warranty period.

In this way, if a client experiences a problem, even years after initial installation, they can call us and we are able to get them up and running quickly.

TechnoFrolics has been in business since 1988, and has a commitment to support its technologies well into the future.

"I'm happy to report that your [FG & SB] exhibits are the ONLY kiosks that I have not had to reinstall/rebuild do any maintenance on and I regularly cite them as examples for how things here should work."

Phillip Manget, Exhibits Department, New York Hall of Science

"It's a testament to the engineering of the [FG & SB] that it is one of the few technology components at the Aquarium that seems to keep working flawlessly with little maintenance."

Billy Spitzer, VP Programs & Exhibits, New England Aquarium

"[... the FG & SB] device is extremely rugged (we have hundreds of digital, multimedia displays here and 1.7 million visitors a year, to put that evaluation in perspective) ..."

Doug Smith, Senior Exhibit Planner, Museum of Science, Boston

"My compliments on your bullet-proof

1 The unique temporal smoothness results from several patented software optimizations in the code.

Inviting "Attract" Mode Draws Visitors

The system offers an intuitive and engaging "Attract" mode (what the system does when no one is touching the dial to encourage exploration), formed by traversing an inviting temporal path through perusable video content.

The instant visitors grab the dial, they are in control of the video at the exact spot where they saw the item that caught their interest.

TechnoFrolics offers creation of this Attract mode as part of its standard provided services.

product. Your [FG & SBs] run, without a hitch, for years!"

Mark Webber, Universal Services Associates

Powerful Lecture Tool

In presentation contexts, the FG & SB offers uniquely precise and fluid control[2]. Specifically, speakers can:

- Move through video footage at dynamically changing rates, adjusting to the complexity of the presentation material and audience comprehension, rather than being forced to keep pace with a fixed, and frequently inappropriate, rate.
- Fluidly and instantly locate relevant sequences from within hours of video when responding to audience questions and areas of interest.
- Seamlessly integrate video and slides with no interruption.
- Return to a table of contents at any point with the press of a button.

"The [FG & SB]'s ease of use and unparalleled scrolling ability dramatically improved the quality of the doctors' live presentations on the exhibit floor."

Charles Read, Creative Director, MJM Creative Services, Inc., New York City, commenting on endoscopic video case study presentations by their pharmaceutical client at DDW and ACG Gastroenterology Conferences.

.....

"The audience stood transfixed gazing at the screen as they were able to watch footage of actual medical cases speed before their eyes or hold in place so they could study them more closely."

Helen von Erck, Marketing/Tradeshow Administrator, ERBE Elektromedizin GmbH

Real-Time Capture: Spin Into History

The FG & SB system can handle streaming real-time-capture in addition to pre-produced content.

Hours (@ 30fps) to years (in time-lapse) into the past is continuously made available to visitors for immediate smooth perusal.[3]

Deinterlacing of video footage is done on-the-fly, such that feeds from standard interlaced cameras and cable feeds (live sports broadcast, medical procedure video, etc.) may be used.

High-speed and HD options are available.

"The real-time [FG & SB] is one of those rare exhibits that captures visitors for extended periods. Many times I have walked past the spinner and seen a family enjoying it, exploring the daily movements of starfish, snails, and other tank creatures. When I'm returning from my errand 5-10 minutes later, they are still there. We normally measure exhibit dwell time in seconds, not minutes! "

Alexander Goldowsky, Director of Programs and Exhibits, EcoTarium

2 Dramatically better for video than alternatives such as PowerPoint.
3 Note that this is not possible with, for example, technologies such as TiVO or other Digital Video Recorders (DVRs) of which we are aware.

Displays can include time tickers that show exactly when events occurred.

Clients can specify daily periods of capture, automatic capture-disabling during periods of darkness, etc.

(For more information, please visit www.technofrolics.com/SpinBrowser/realtime.)

Easy To Configure & Customize

TechnoFrolics' system can be customized in various ways including:

Functionality / Software

- Adjusting the rate of dial perusal through content, where such things as low speed progression rate, high speed exponential progression rate, speed caps, and more, are all easily changeable.
- Graphic overlays may optionally pop into view based upon whether the dial is being turned or not.
- Audio tracks may selectively play when the visitor is viewing certain content areas.
- A table of contents may be added to allow users to select from a set of available video clips.
- With code changes, virtually any customization can be achieved.

The ability to adjust the dial progression rate is particularly critical in situations where video content is of substantial length, and/or includes processes of vastly differing time scales.

Physical Embodiment / Hardware

- The system may be designed as a stand-alone kiosk, flush-mounted into a wall, or composed of podium-mounted dial with imagery projected onto a floor, wall, or ceiling.
- The PC can range from a rackmount server to lightweight laptop.
- The display can be a flat-panel screen or projector.
- The dial can be large and rugged for museum & tradeshow use, or small and lightweight for portable applications.
- Buttons, and exotic custom-designed users interfaces, may be used to provide additional or unique functionality.

(A complete feature list is available in Appendix B.)

We encourage you to zoom-in on the client thumbnail photos at the beginning of this document, in order to get ideas for different installation options.

As part of an NSF (National Science Foundation) grant, we prototyped a system where, via a pressure-sensing drum pad, deaf individuals could "play" the blooming of a rose like a visual analog of a musical instrument.

More recently, we constructed an interactive skating exhibit whereby foot motions breaking laser beams, and realistic virtual physics, allows visitors to experience some of what it is like to be a professional hockey player.

Dedication, Innovation & Design Assistance

As the inventor of and patent holder on the technology, we are constantly improving and enhancing our trademarked FG & SB system.

And as a group, we are both fun and responsible, and support our technology 100% pre and post sale. As one element of this, we offer design and content suggestions throughout the project (we are experts in FG & SB video production), whether we are the producers of such content or not.

Going further, in cases where we are not the producers, it is frequent that we loan a fully functioning laptop-based system to the group that is, in order to help and inform their production work.

Competitive Advantages

The majority of institutions and individuals familiar with the FG & SB system (comprised of software, hardware, and services), consider it to be an excellent value at the price.

Nevertheless, occasionally a project will evolve where a decision is made to attempt to recreate independently a subset of FG & SB functionality, sometimes using 3rd party components with little or no prior full-system testing[4] in museum or similar high-use environment.

Quite separate from potential patent infringement issues, and hopefully avoiding the appearance of overly self-serving promotion, we would like to note that past real-world examples (see sidebar) indicate this route presents significant risk of subpar visitor experiences, unreliable exhibit functioning, and increased cost in the long run.

"TechnoFrolics is a highly reliable production group. David and company are both technically proficient and aesthetically sensitive, a rare combination. They pay attention to fine details and ask the right questions. They deliver on time and on budget."

Doug Smith, Senior Exhibit Planner, Boston Museum of Science

"TechnoFrolics' crew was delightfully easy to work with and thoroughly knowledgeable not only about their product but about the world of IT in general."

Helen von Erck, Marketing/Tradeshow Administrator, ERBE Elektromedizin GmbH

"David Durlach is, by far, one of the most dedicated and inventive people with whom we have had the pleasure of working. His devotion to reaching people of all ages, genders and cultures through the integration of science, art and personal experience is rare and welcome indeed. Science centers, children's museums and other informal learning centers are crying out for innovative exhibitry that reaches a broad audience, and David's philosophy and work fit this bill perfectly."

Sharon Rupe, Senior Project Manager, Hands On! Inc.

"Using the 'ABC' product confirmed my preference for the [FG & SB] technology.

(Upon request, TechnoFrolics will be happy to identify product 'ABC', and provide the name of the multimedia producer quoted below. We omitted these items in this public document simply out of discretion.)

The 'ABC' wheel feels cheesy and not positive (the impact on the video progression seems tenuous). One unit has broken after less than 4 months of museum use. The biggest

4 As one important example, unless the user interface and nearby components have been designed for, and repeatedly tested with, high voltage static discharges similar to what visitors will generate (as all TechnoFrolics-provided components are), the chance of reliable exhibit functioning is low.

We have learned from experience that in such circumstances:

- Too often the client, specifying designer, and/or AV/fabricator, did not have sufficient information up front to properly assess their options and evaluate true costs. (In particular, we wish to note that Flash provides nowhere near either the performance, or features, the FG software provides.)
- One or more parties were under destructively-intense financial pressure to cut short-term costs, even at the expense of visitor experience, exhibit reliability, and long-term costs. (On bidding intermediaries, this pressure can be particularly severe.)

In response to the above, we have done several things:

- Prepared this document to help explain key issues and describe our system's strengths, advantages, and value.
- Increased the flexibility of our offerings in terms of how much we provide vs. what is provided by others, in order to better address the differing needs (both financial and functional) of various groups such as: end-clients, designers, multimedia/video producers, fabricators, AV firms.
- Made a commitment to help and support our colleagues, partners, and clients through all stages of the specification and production process, through both advice and free loan of demo units.

drawback is that they're not exponential in fast forward mode. When you look at (say) time-lapse of building construction, you're stuck at a very low rate. It gets monotonous..."

A multimedia producer and repeat FG & SB user/specifier, commenting on a museum exhibit where, against strong recommendations by the designer to use TechnoFrolics' system, a jury-rigged industrial DVD player was used instead.

In another instance, a local entertainment destination franchise owner employed a similar system, and operation was so below FG & SB quality (with which corporate was familiar, having used it in the past), that corporate pulled it off the floor.

Applications Summary

- Museum, aquarium, zoo
- Lecture and presentation (education; sales)
- Medical procedure capture & review
- Factory automation analysis and QA
- Virtual tours & wayfinding
- Technical training (assembly; repair)
- Security and reconnaissance
- Research and engineering (hard/soft sciences)
- Information archive access and perusal
- Performance and lobby art

For more information on TechnoFrolics' FG & SB video explorer, please contact us. And if you would like a demo unit to experience live, 100% free of charge or obligation and something we strongly encourage, please let us know. We are confident that your experience will exceed your expectations!

"The [FG & SB] has been great fun for our office. ... I also brought it home for my 6 yr old son to try out! He loved it!" **Brian Burgess, Lex Parker Design Consultants, Ontario**

"I made the 'mistake' of setting up your demo just outside my office. Due to its popularity, there was a constant flow of people coming by to play and chat - it made my getting any work done a nightmare! Seriously though, thanks much for sending the demo - it has been invaluable in helping our group brainstorm about potential applications to our projects." **Steve Bergeron, Director of Production, Aspen Marketing Services**

"It's fun. It works. I love it. Very elegant." **Don Weinreich, Polshek Partnership Architects, New York City**

(For additional info on the touring unit, and booking a visit to your location, please see www.technofrolics.com/touringspin.)

Appendix A: For Aquariums, Zoos, and Botanic Gardens

How does the FG & SB video explorer enhance a visitor's knowledge and enjoyment of nature?

Springboarding off visitor experiences with live animals and walks through nature, the FG & SB system offers additional understanding and intimate views of the environment, very difficult to get by other means.

Sometimes this unique view comes from expanding or compressing time, and sometimes from expanding or compressing space. In either case, the technology allows visitors, in a simple and intuitive manner, to take unique journeys that result in continuous new discovery.

Specifically, the FG & SB is ideal in situations where:

1. **Animal or plant motion is too slow** to be fully perceived under normal viewing conditions - e.g., sea stars and snails moving and feeding, animals maturing (baby-to-adult, caterpillar-to-butterfly), vines growing, flowers blooming, etc.

2. **Animal or plant motion is too fast** to be fully perceived under normal viewing conditions - e.g., archer fish spraying their prey, a chameleon's tongue grabbing an insect, a bunchberry dogwood flower opening[5], etc.

3 **Animal motion is too complex** to be fully perceived under normal viewing conditions - e.g., direction changes in schooling fish, a centipede walking, worker bees communicating with their queen, etc.

4. **Animals are too big** for standard tanks, or **vegetation too big** for transplanting - e.g., a sperm whale, giant redwood, etc.

5. It is desired to **show rare events** - e.g., a seal giving birth, a snake eating or shedding its skin, 17 year Cicadas, a bird mating dance, etc.

6. It is desired to allow visitors to take **interactive tours of animals' and plants' natural habitat** - e.g., a 10 hour uncut shot from a jeep traversing the Serengeti Desert, from a submarine navigating the Great Barrier Reef, walking along the trails of a nature preserve or botanic garden, etc.

7. **Images of animals or plants are not otherwise available** - due to their cost, rarity, limited aquarium/zoo/garden space, vast archived quantity, etc.

8. It is desired to add **educational text or audio annotations** to animal and plant images.

9. It is desired to **make areas of your facility available to the physically handicapped**, that would be otherwise inaccessible.

5 This occurs in just a couple of milliseconds!

Appendix B: Technical Features List, 1/15/2011

(Note that this 5 page list duplicates some previous content, but is much more extensive. Its intended audience is the technically-oriented exhibit designer/producer.)

1. **Unparalleled fluidity and fine control**, from stop frame to millions of times the normal rate, based on user-controlled motion through video content, both Standard Def (SD) and High Def (HD), created from shot video and/or high-res stills. (The unique temporal smoothness results from software optimizations including multi-threaded, multi-core parallel operation, synchronization to display screen refresh scans, and more.)

2. Capable of handling **video content up to terabytes in size** - think weeks of SD at 30fps, or years of time-lapse in HD.

3. Uses **standard format QuickTime movies** as input, so video production may be accomplished using virtually all standard production tools.

4. Perusal of either **pre-produced content, live capture video streams** right up to the present moment, or both. (For live capture, sources may be any mixture of analog, LAN/GigE, Camera Link, HTTP URL, folder of JPEGs, etc.)

5. **Attract mode** that is entered after N configurable seconds of user inactivity, designed to grab the attention of passersby. This Attract mode is composed of either:
   - (Recommended) A temporal path through perusable video content, where the instant the user grabs the dial, they are in control at the scene exactly at the point that caught their eye.
   - A separate movie or still that vanishes the moment the user grabs the dial.

6. Completely **configurable relationship between dial motion and movement through video** including setting:
   - The linear "gear ratio" between dial movement in degrees and frame advance.
   - Two independent thresholds, in both dial velocity and rotation, at which movement becomes exponential (required for quickly traversing large amounts of video content while still providing fine control at the slow end).
   - Velocity cap on video traversal speed, independently settable on a movie-by-movie basis (to prevent users from inadvertently "flying through" short sequences that may be adjacent to long ones).

7. **Additional inputs and outputs** (the latter for button illumination lights, or other more exotic content section highlighters) where:
   - Button presses can deposit a user at a certain place, begin playing the video with audio from the current location, enable/disable text overlays, etc.
   - Lights can be turned off/on based on where one is in the movie sequence, whether a button has been depressed, etc.
   - RFID-based cuing, whereby visitor object placement can cue specific behaviors and content clips.
   - Custom sensor inputs, with associated custom virtual physics. Examples include:
     - ◊ A virtual point-of-view skating experiences with realistic acceleration, ice friction, etc. (An actual produced exhibit).
     - ◊ An interactive science-artwork, where the higher the frequency of sounds sung to it, the faster the motion

through a point-of-view tour of the streets of Vienna. (A readily do-able concept.)

8. **Graphic and text overlays**, whose appearance is based on:
   - Location within a movie.
   - Whether in Scroll, Attract, or Play modes.
   - Button presses.
   - Length of time visitor dwells within a certain section of content. (So for example, the longer a user stays exploring a given section, the more supporting annotations they receive.)
   - Velocity of dial.
   - Minimum visibility time.

9. **Optional audio:**
   - As overlay: In this mode, an audio annotation clip plays once, or looping, when the user enters a certain section of the video content. (See above for options as to when audio starts, stops, etc.)
   - In synchro-lock: In this mode, audio and video play together at either the normal rate (like a conventional presentation), or at various configurable multiples faster or slower than normal. Play may be set to occur upon a button press or after a timeout period of no dial motion.

10. Configurable **on-screen digital clock** showing frame capture time (relevant to live capture installations).

11. Configurable **on-screen progress bar**, including dynamic alpha blending onto live capture.

12. **Flexible scripting language** to allow for complex functionality.

13. **Control of multiple screens** with a single dial, such that different but related content may be perused in dead-on frame lock (e.g., a point-of-view journey, filmed left, right, and center). Or have completely separate visitor stations, each with their own dial and unique content, running off a single PC. As of Q4, 2010, three 720p HD screens, each with their own content, controlled by 1, 2, or 3 dials, may be run off a single multi-core PC.

14. **Sophisticated hardware assessment tools and ongoing system monitoring** including:
   - Creation of **log files** at each run instance, containing detailed system information, date and time, errors (if any), etc.
   - **Automatic emails** to key client and TechnoFrolics staff **in the event of a system error.** (In the rare event there is a problem, often we are alerted, and have fixed things via remote logon, before you the client is even aware there is an issue.)
   - Ability to **reboot the computer on error**, nightly to "clean up" the OS, etc.
   - **Timing logs** to allow assessing speed of computer hardware, separated into computation, disk access, graphics card memory transfer speed, etc.
   - **Automated integrity checks of streaming capture data** files, hard disk file structure, and more.

15. For **live, streaming capture**:

    Think a year's worth of **HD weather** outside a building up to the present moment, **24 hours in the life of a starfish**, high-speed live capture of **water droplets**, procedure-based **medical education**, etc.

(Technical Features List, Continued)

- ***AT CAPTURE TIME:***
  - ◊ Sophisticated, configurable, **automatic exposure** settings.
  - ◊ **Streaming capture and review of multiple time-locked HD video streams.** (Of particular importance within the medical field where, for example, optical endoscope data is often supplemented by ultrasound and other related imagery.)
  - ◊ **Capture of audio synchronized to video.**
  - ◊ User configurable scripts to select what days, and time of day, capture to disk occurs. The system includes calculation of sunrise and sunset, based on the exhibit's latitude & longitude, and the current date, so daily **capture start and stop times can be relative to sunrise/sunset**.
  - ◊ **Ability to capture at multiple frame rates.** For example, in time-lapse installations, it is straightforward to have the last 24 hours captured at 1fps (to allow, for example, seeing birds in flight and smooth cloud motion), and the previous year at 1/10fps (to allow for sane disk storage requirements).
  - ◊ **Ability to perform "Cluster Capture".** Historically, time-lapse has been shot by taking 1 frame every periodic interval of time - once per minute, once per day, etc. For subjects in which there is no fast motion - such as a flower blooming - this is fine. However, there are many scenes where interesting evolution is occurring on multiple time scales. Examples include tides in the ocean over 12 hours (where the motion of waves, sea birds, and the like, is occurring relatively quickly), building construction over years (where the pounding in of pipes, motions of cranes and backhoes, and the like, are similarly occurring relatively quickly), the maturation of a young chick over weeks, etc. In all these multi-timescale cases, conventional time-lapse loses dramatic amounts of real-time information and is frustrating because of this, as well as being annoyingly jerky. And of course it is not practical to simply film the sequence continuously over weeks or years at 30fps, both because it would take untold numbers of hard drives, and because no one would watch it (at least not running in real-time).

    Cluster Captured content, presented on the FG & SB, dramatically improves this situation. With this technique, footage is captured at real-time at 30fps for X minutes (say 1/2 minute), then capture pauses for Y minutes (say 30 minutes), and then the cycle repeats. In this way, with the exception of the occasional periodic "jerks" at Y+X minutes, the user experiences smooth, full frame rate control when turning the dial slowly and thus can readily explore the relatively quicker motions. However, when turning the dial fast, the experience is just like with conventional time-lapse. You thus have the best of both worlds.
  - ◊ **Automatic darkness detection**, and automatic scene stillness detection, which can be used to disable capture when nothing of interest is happening.

- ***AT DISPLAY TIME:***
  - ◊ Reversible **brightness, contrast, and contrast-offset adjustments**, that are applied at image display time based on the time of day. (In this way, one can capture continuously into the beginning of darkness in a manner that minimizes image graininess, as well as reversibly tweak parameters to find best-quality screen settings.)
  - ◊ The ability, dynamically and reversibly, to choose how much of the day to show the user. In other words, **adjustment of how deep to go into sunset and sunrise** without destroying previously captured data.
  - ◊ Ability to quickly and reversibly **exclude any section of captured content** (for example, if a visitor moons the camera :-).
  - ◊ Several options for **on-the-fly deinterlacing**.
  - ◊ **Chroma-keying and difference-keying**. In addition to conventional chroma-keying, the system allows taking a "snapshot" of the background, and keying out the foreground based on a difference engine. In this way, the difficulty of uniformly lighting background color mattes in museum environments vanishes,

as unevenly lit screens work just as well as evenly lit ones.

- ◊ Camera sensor **"bad"/"hot" pixel removal** from image. (All camera sensors have "bad" or "hot" pixels that result from physical defects. This feature detects them, and replaces them with surrounding "good" pixels, dramatically increasing image quality in low-light situations.)
- ◊ **Changing which video feed's content is in view** (for multiple camera/image-stream installations).

- **RGB histograms** stored with each captured frame and (optionally) overlaid onto the screen to assist in setting camera exposure.
- **Automated, redundant backup system** capable of handling terabytes of data, and designed specifically for museums and other similar environments. (Critical in, for example, extended weather capture installations, where losing a year's worth of captured data is not an option.)
- Able to **save to RAM** (for ultra-high data rate high speed cameras) **or to disk** (for more "conventional" capture situations).
- **Time and date of capture stored with each video frame** and visible during later visitor review.
- Ability to **export any section of captured content** to a standard format Quicktime movie, at original or decimated frame rate.

16. Miscellaneous:
    - **Recognizing touch screen events** and responding.
    - Configurable graphic **Table of Contents**.
    - **Segmentation of video content**: Content may be configured as one long seamless loop (what we generally recommend), or divided up into several logical, self-contained sections accessed by, for example, button presses.

17. More **research oriented and/or exotic:**
    - **See www.temporalinnovations.com, for information regarding high speed data filtering, and time progression via mathematical functions, applicable to both research and exhibit contexts.** Examples include:
        - ◊ Viewing (say) **bird behavior only** at times N visitor-settable milliseconds before or **after a warning screech**, where each screech is possibly hours apart.
        - ◊ **Seeing only sunsets**, or only days less than 0 DegC, in a year's worth of HD weather capture.
        - ◊ **Virtual strobing**, such that users can choose a strobe frequency with which to examine phenomena, and then use the dial to move through those strobe-selected frames.
        - ◊ Observing a filmed clock hand, with **time run sinusoidally**, where the motion then immediately and unmistakably looks like a pendulum in a gravitational field.
        - ◊ Filming marbles being placed uniformly into a glass bowl, and then **running time first linearly, then exponentially**, portraying the extraordinarily rapid growth of bacteria, human population, depletion of natural resources, etc.
        - ◊ Watching **child/teacher behaviors in a classroom** only at those times where there is a peak in the synchronized recorded audio (i.e., at times of an "outburst" :-).

Available Upon Request

1. **Movie progress determined by sensor input of sound, light, temperature, etc.** For example, imagine an interactive science-artwork, where the higher the frequency of sounds sung to it, the faster the motion through a point-of-view tour of the streets of Vienna.

2. Collecting **statistical information on user dwell time**, sorted by movie content area, in order to assess audience interests.

3. **Audio pitch change** as a function of perusal speed.

4. Virtual capture devices composed of client-filled **folders of still images**, where system automatically generates a **user-settable-duration cross-dissolve between images**.

Appendix B covers only a fraction of the features of our FrameGlide video explorer with Spin Browser dial. Please contact us for further information.

(And for research and other data-filtering needs, please be sure to check out www.temporalinnovations.com.)

(GUI Screen Captures, Example Configuration Files, and Sample Scripts follow in Appendix C.)

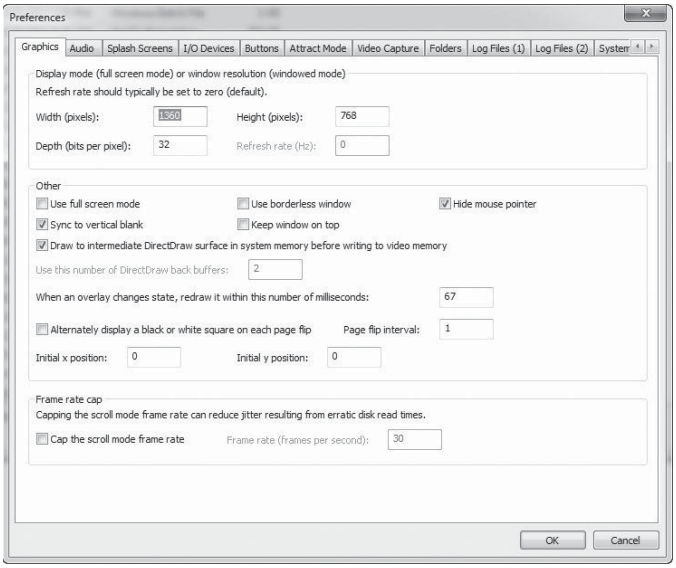
Appendix C: Config Files, GUI Screen Caps, and Scripts 6/9/12

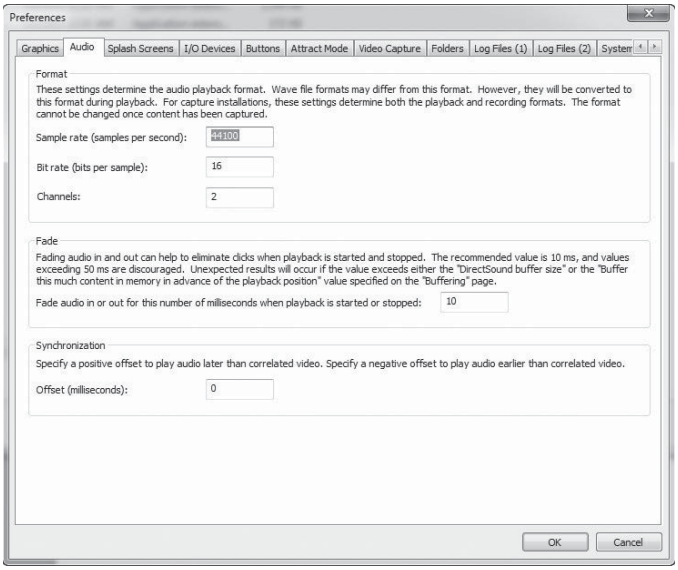
(Example Tracklist.txt configuration file.)

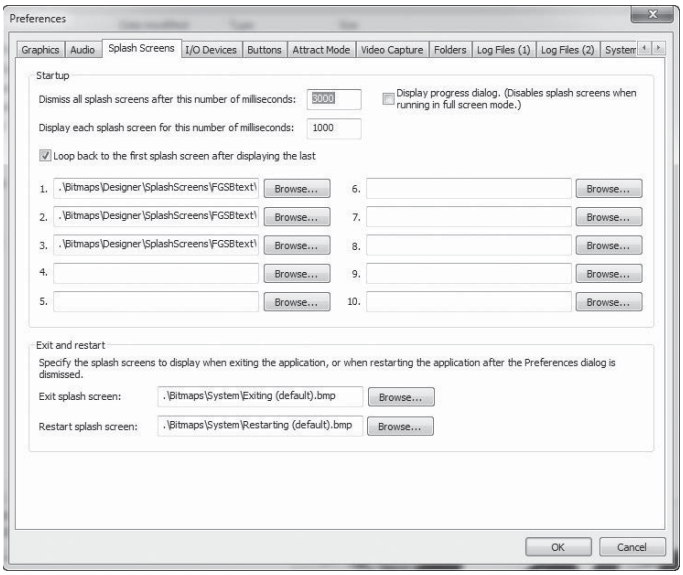
```
DEFAULTS

ENCODERSENSITIVITY 9                ;Encoder sensitivity in milliseconds of track time per degree of encoder movement.

ENCODEREXPBASE1 1.0015              ;Exponential base 1.

ENCODEREXPPOSTHRESHOLD1 180         ;Exponential position threshold 1 in degrees.

ENCODEREXPVELTHRESHOLD1 180         ;Exponential velocity threshold 1 in degrees per second of real time.

ENCODEREXPBASE2 1.0022              ;Exponential base 2.

ENCODEREXPPOSTHRESHOLD2 360         ;Exponential position threshold 2 in degrees.

ENCODEREXPVELTHRESHOLD2 720         ;Exponential velocity threshold 2 in degrees per second of real time.

ENCODERVELCAP 400000                ;Velocity cap in milliseconds of track time per second of real time.

FRAMERATE 30                        ;Framerate of video - overrides internal file settings.  -1 to lock to synchronized audio track.

LOOPSCROLLING 1                     ;Make video a seamless loop (0 or 1).

LATCHONENTRY 1                      ;Don't fly through short movies (0 or 1).

CROSSDISSOLVEDURATION 500           ;When switching to this track from another track, the duration in milliseconds of cross dissolve.

SMOOTHPLAYBACK 1                    ;If 1, frames are never skipped during playback, however the playback frame rate may be lower than
the specified frame rate when the content data rate is high.  If 0, the playback frame rate matches the specified frame rate, however frames
may be skipped when the content data rate is high.

PLAYMODE stop                       ;Determines playback behavior after reaching the end of a QuickTime movie:
                                    ;       "stop"          Stop playback and remain at the last frame of the movie.
                                    ;       "stopnexttrack" Stop playback and go to the first frame of the next video track.
                                    ;       "continue"      Playback the next QuickTime movie in the track.
                                    ;       "loop"          Playback the current QuickTime movie from the beginning.


VIDEOTRACK

MOVIE ..\Movies\01BlackToGlassBreak.mov     ENCODERSENSITIVITY 5    ENCODERVELCAP 20000     ;Override defaults.
MOVIE ..\Movies\02GlassBreak.mov
MOVIE ..\Movies\03Balloon.mov
MOVIE ..\Movies\04Bird.mov
MOVIE ..\Movies\05Drops.mov
MOVIE ..\Movies\06RedSox.mov                FRAMERATE -1            ;Override default.
MOVIE ..\Movies\07RedSoxToBlack.mov         ENCODERSENSITIVITY 5    ENCODERVELCAP 20000     ;Override defaults.

AUDIOTRACK

WAVE ..\Audio\06RedSox.wav ..\Movies\06RedSox.mov


VIDEOTRACK

MOVIE ..\Movies\2ndVideoTrackPartA.mov
MOVIE ..\Movies\2ndVideoTrackPartB.mov
```

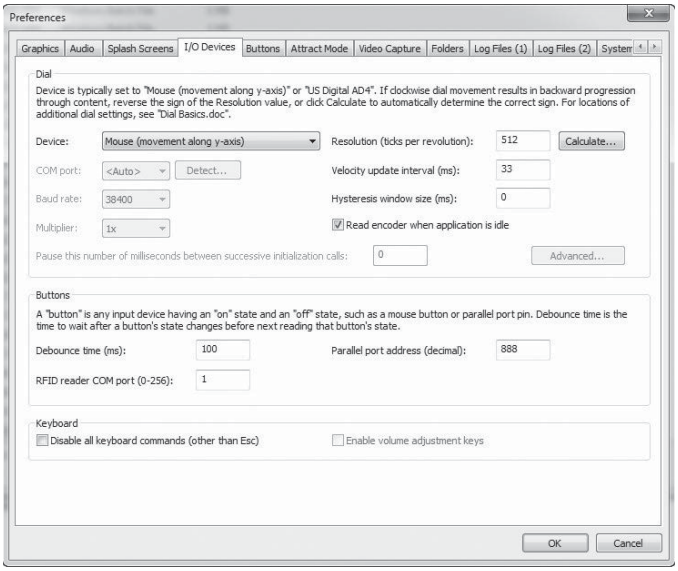
(Config Files, GUI Screen Caps, and Scripts, Continued)

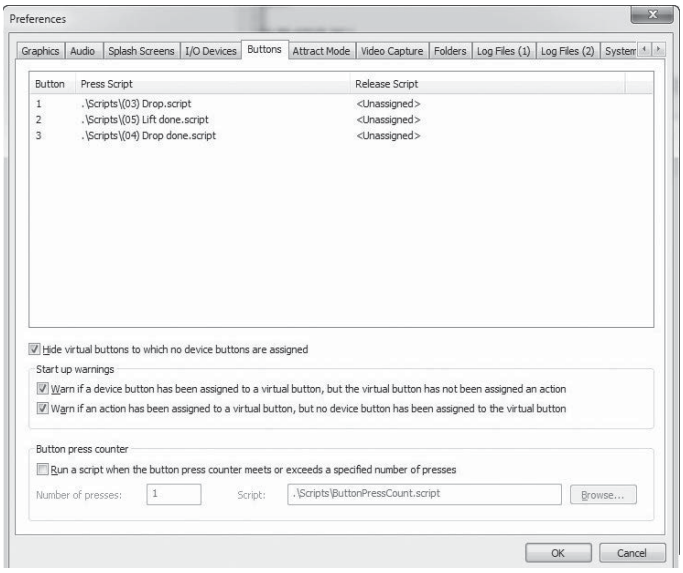
(Main GUI.)

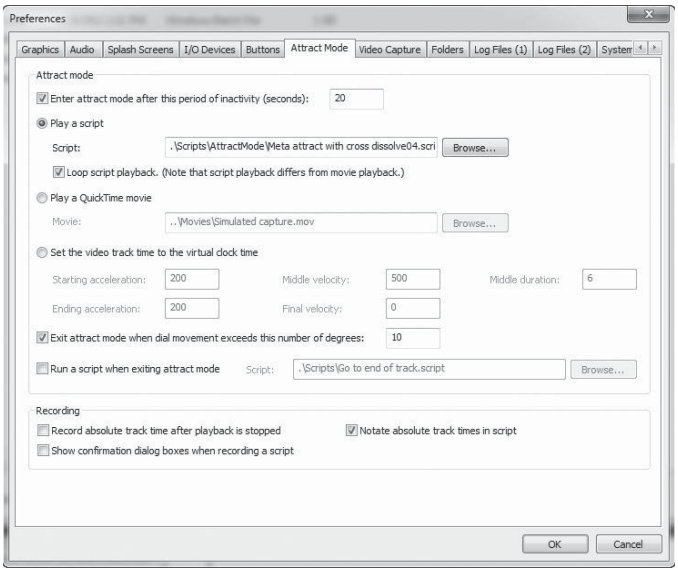






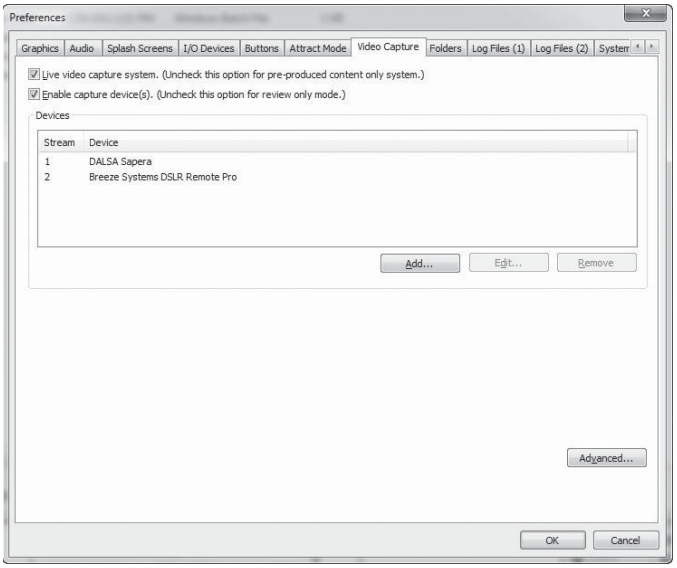


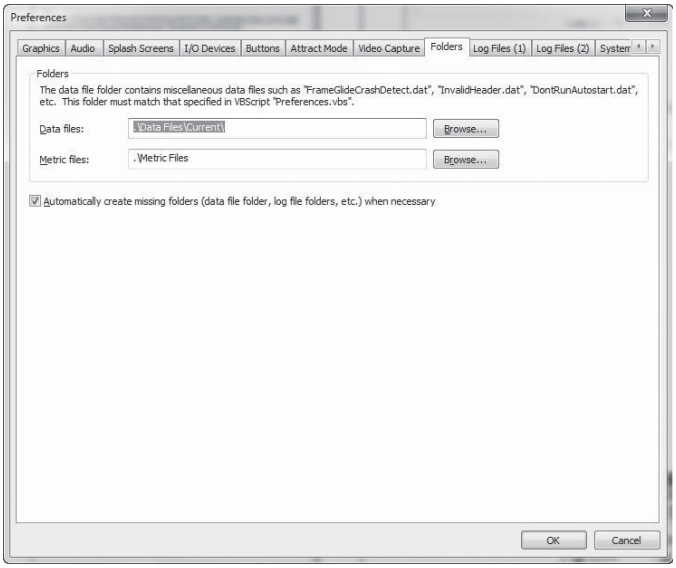


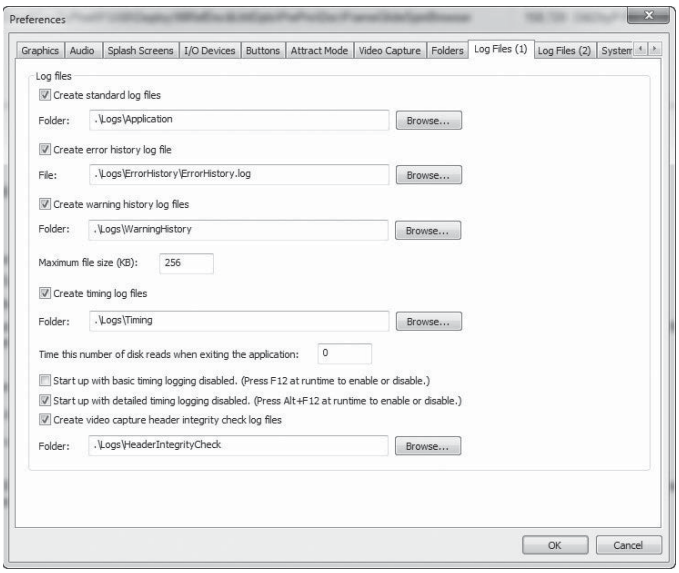


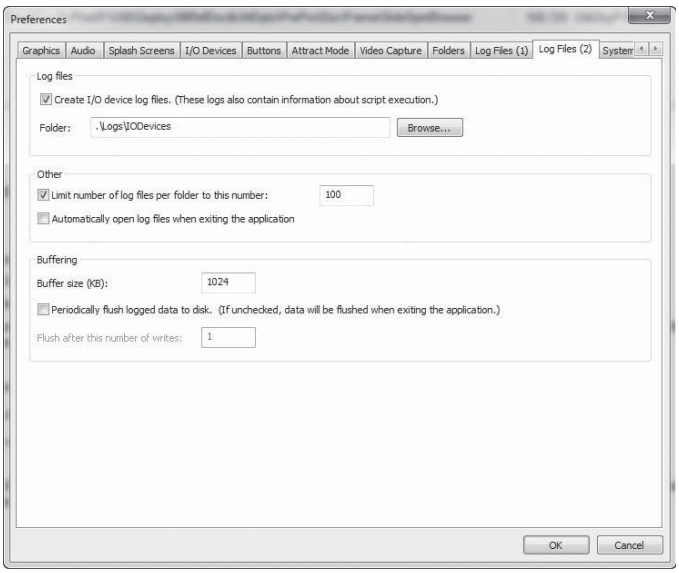
(Config Files, GUI Screen Caps, and Scripts, Continued)

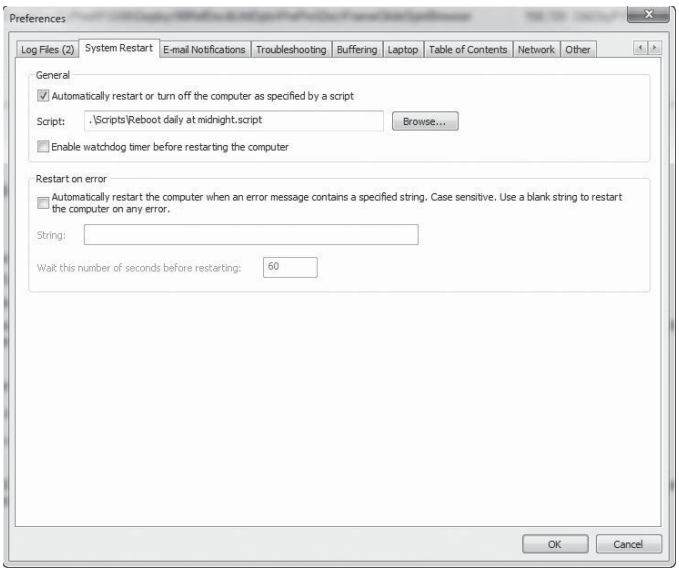
(Main GUI, Continued.)

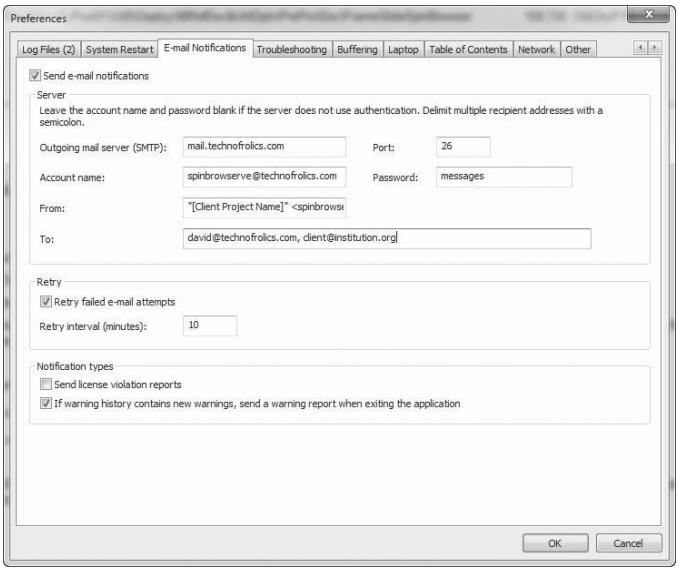




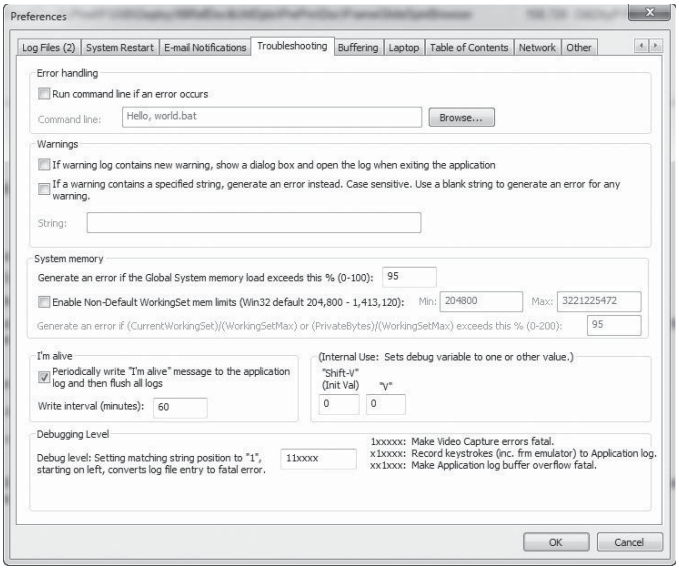


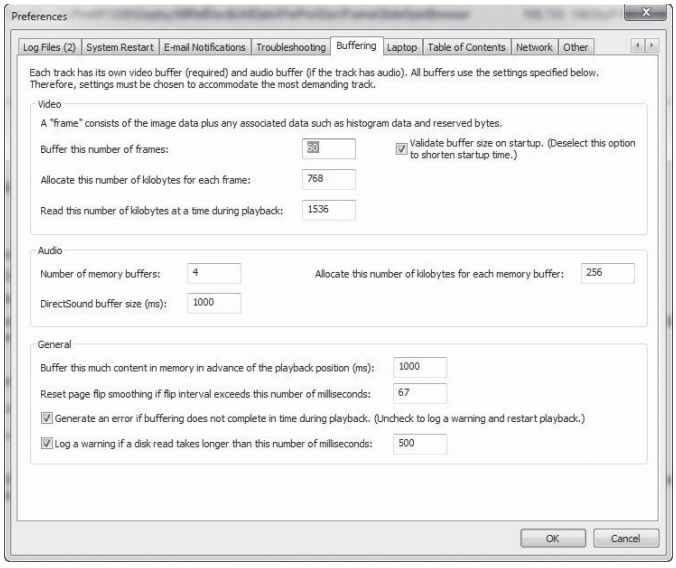


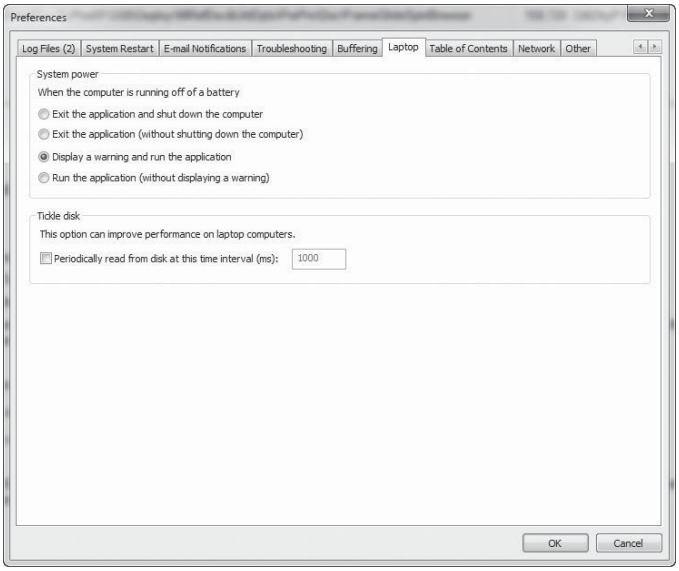


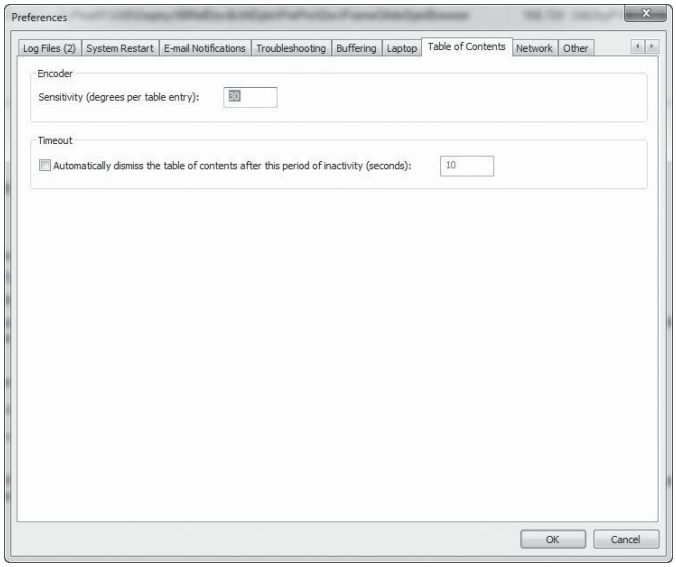


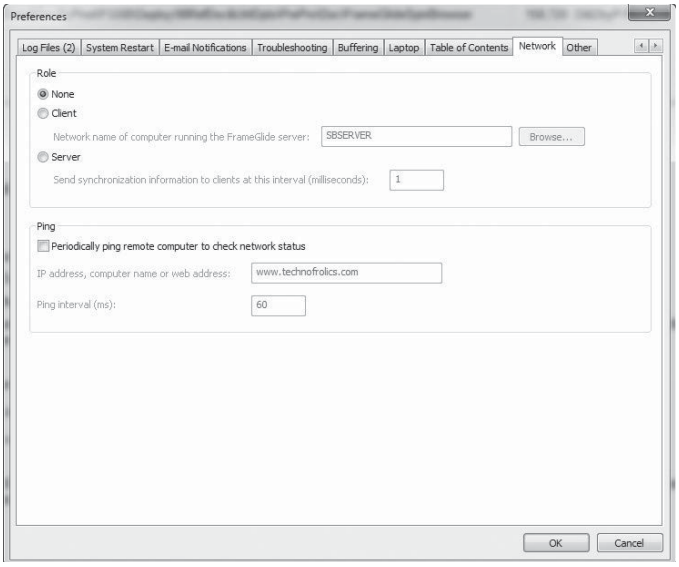
(Main GUI, Continued.)

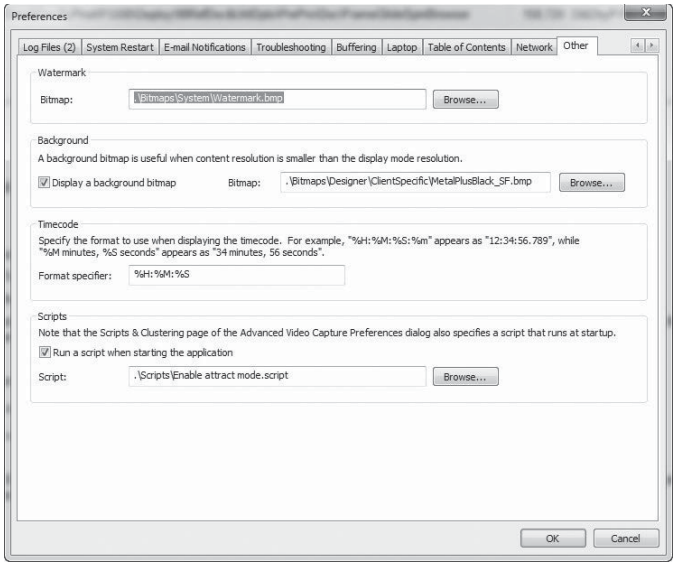




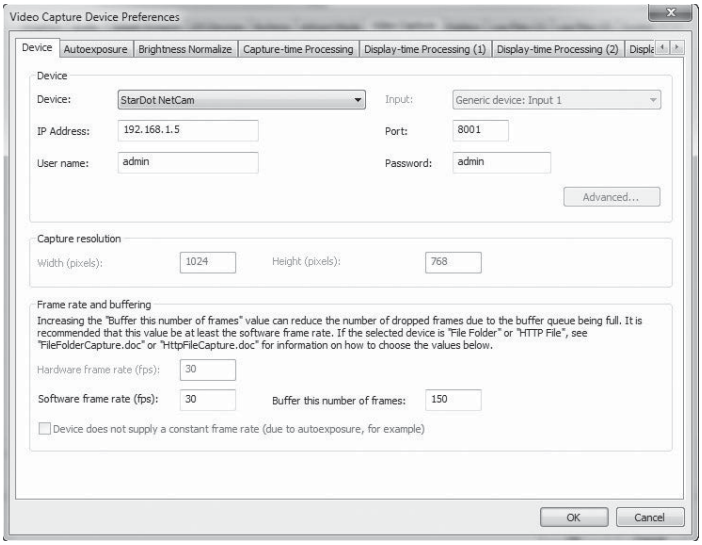


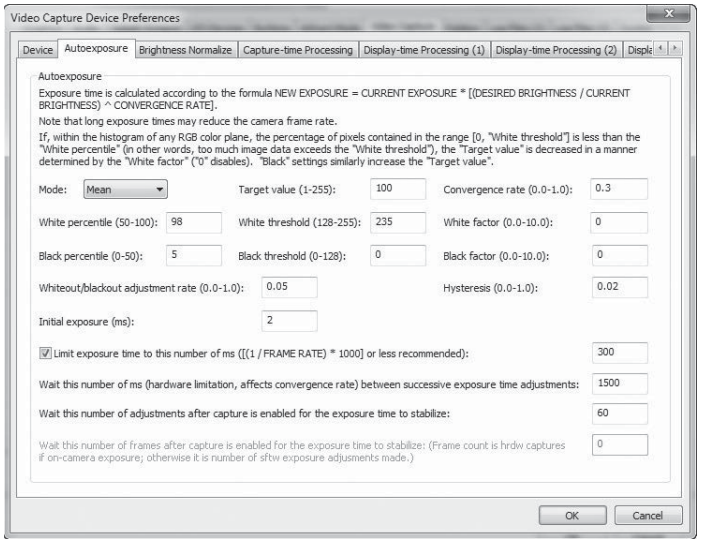


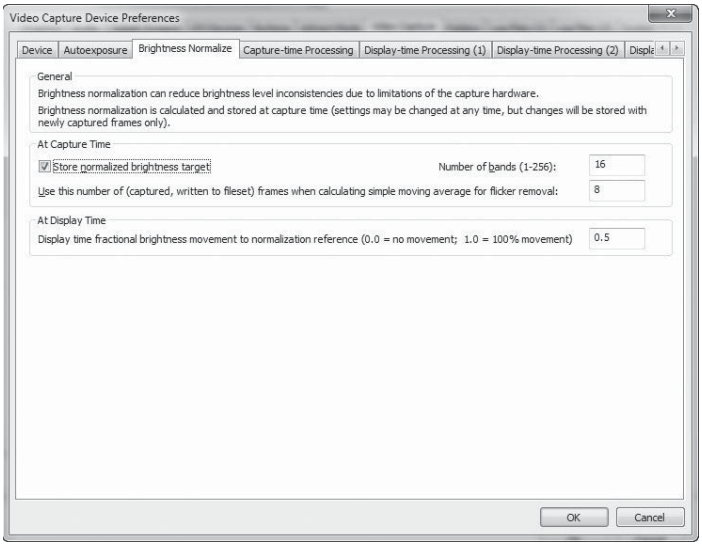


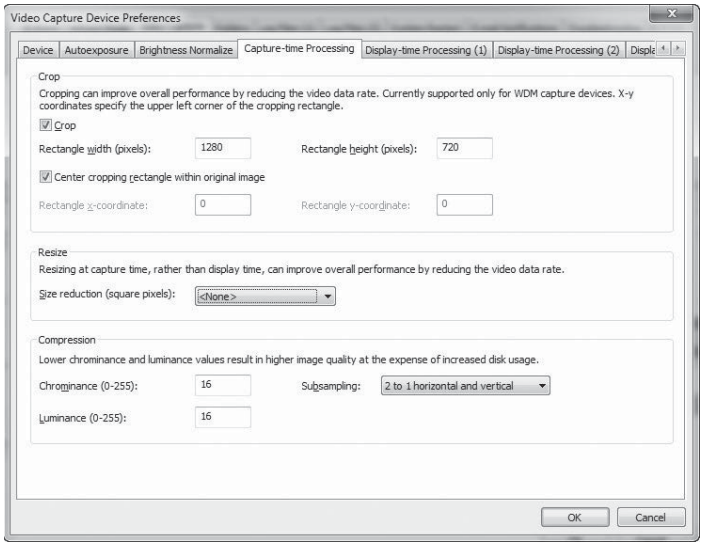


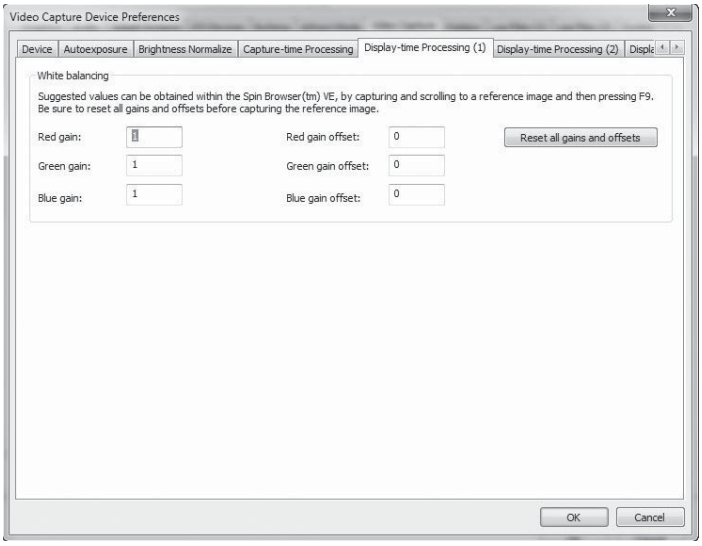
(Video Capture GUI - Primary.)

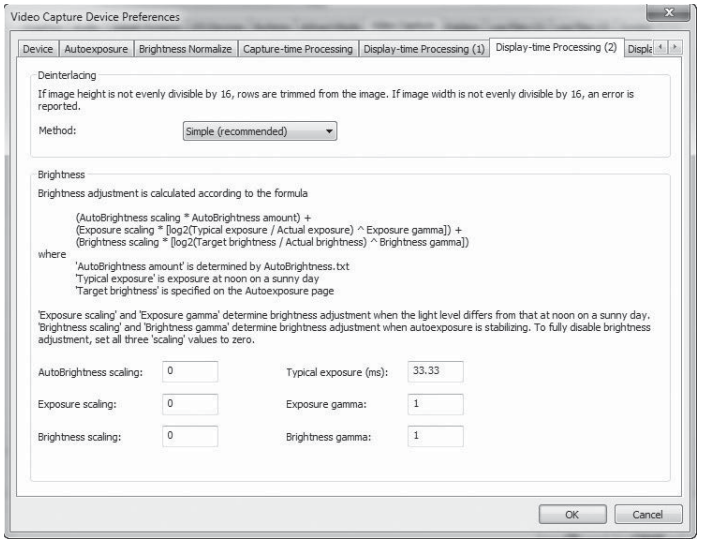




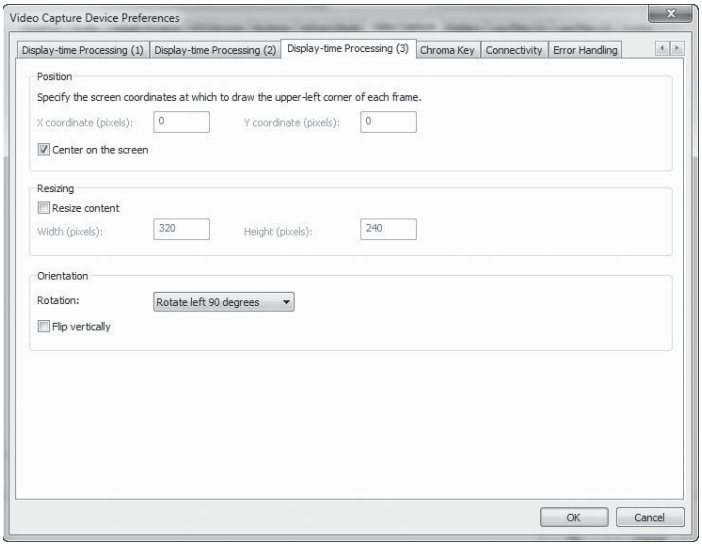


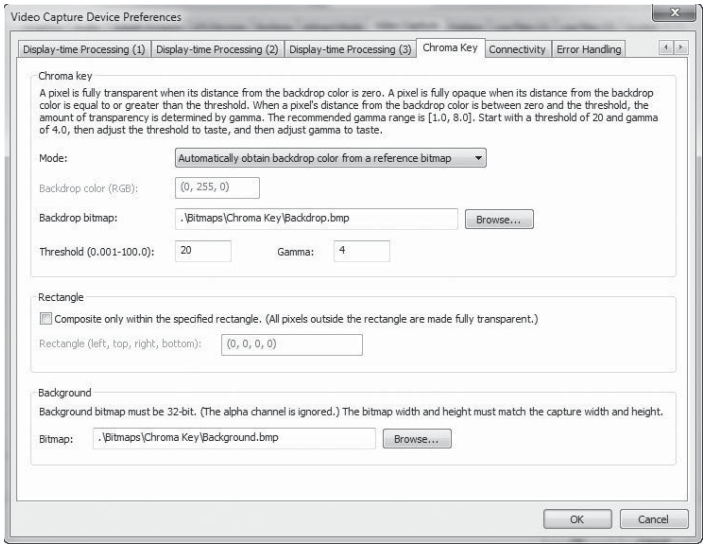


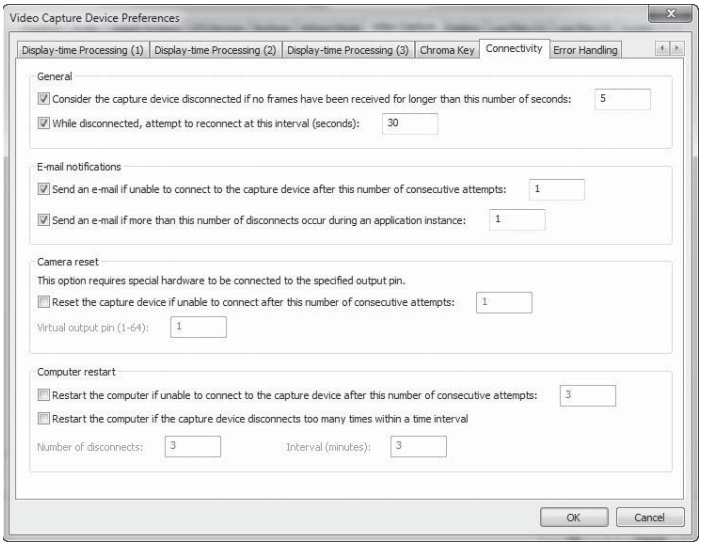


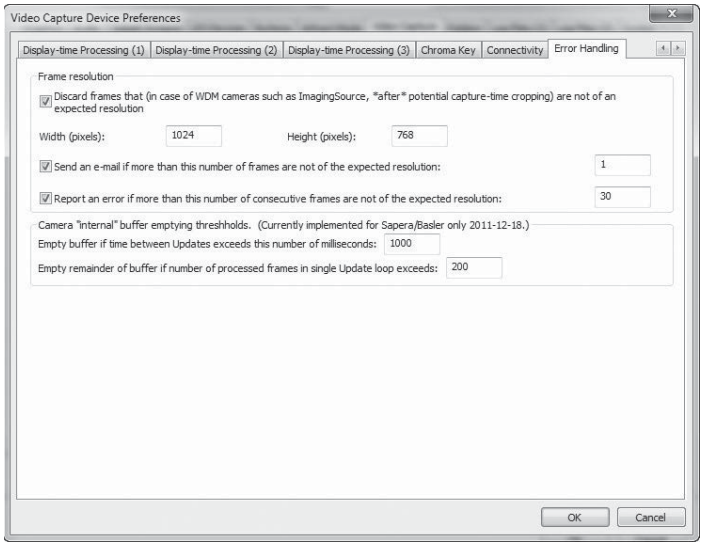


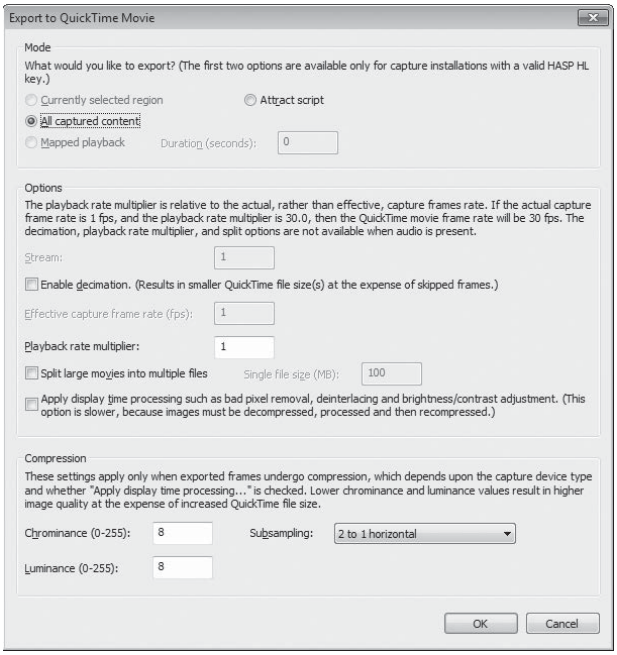
(Video Capture GUI - Primary, Continued.)







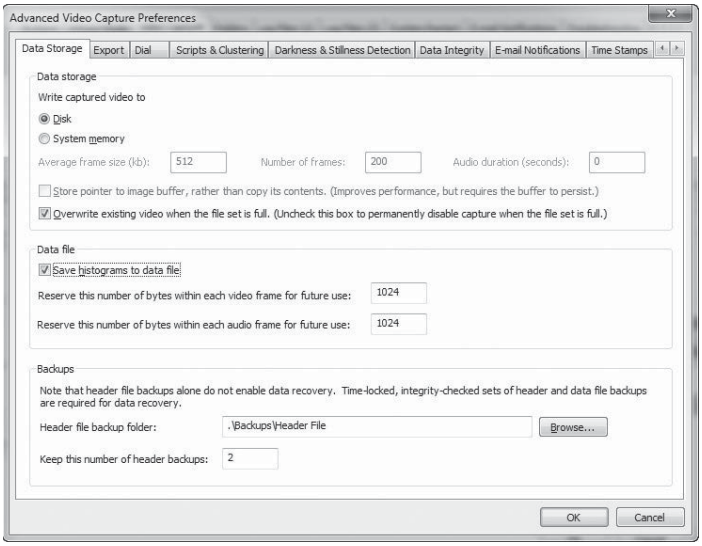


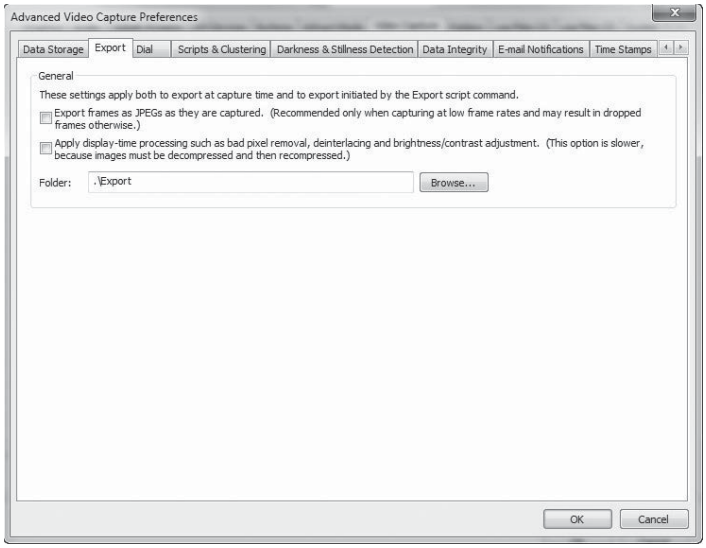


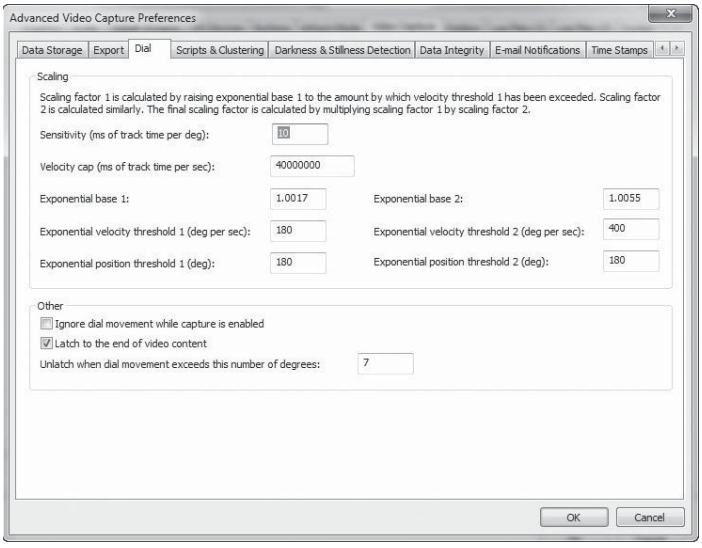
More follows....

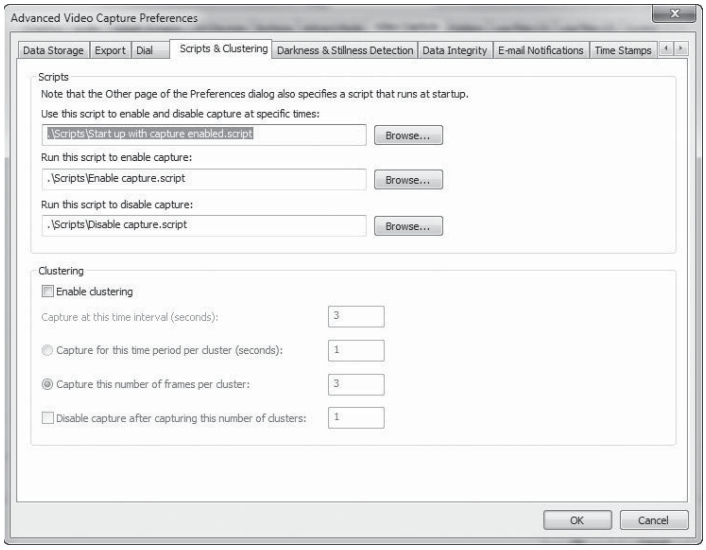
(Config Files, GUI Screen Caps, and Scripts, Continued)

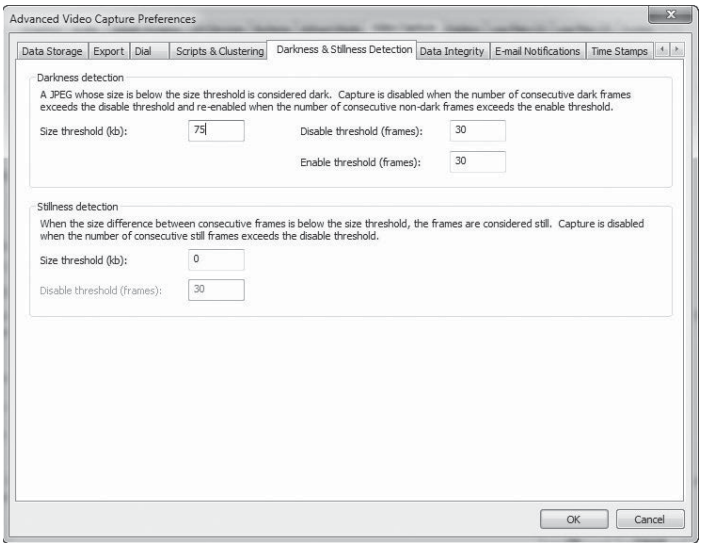
(Video Capture GUI - Advanced.)

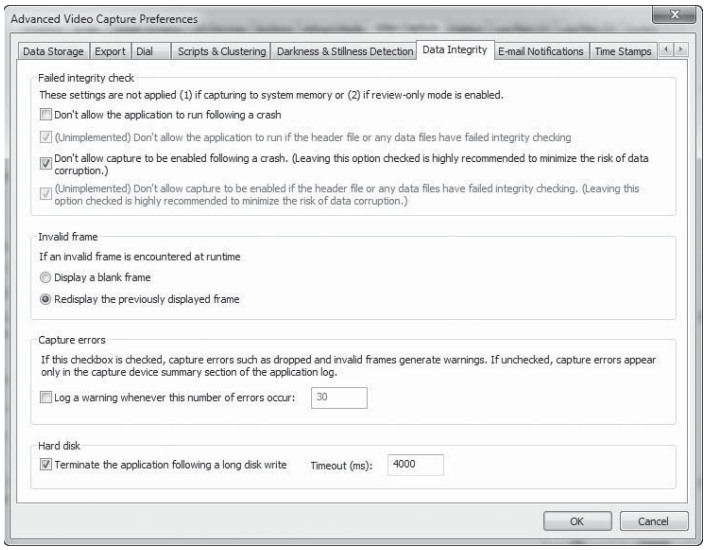




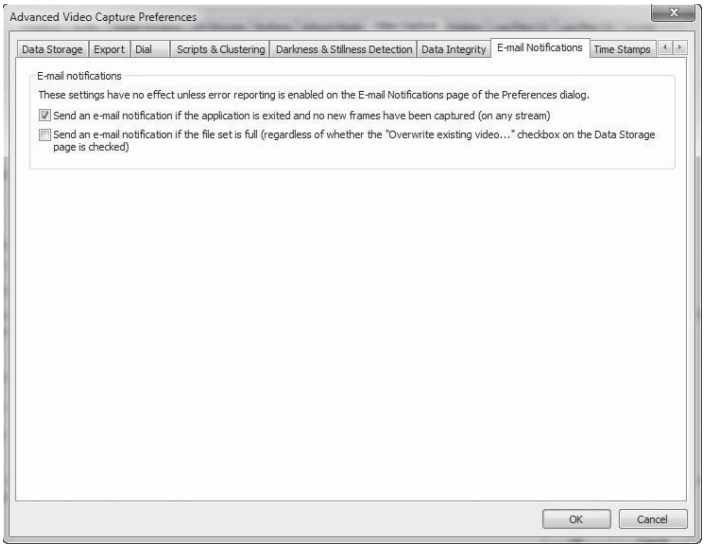


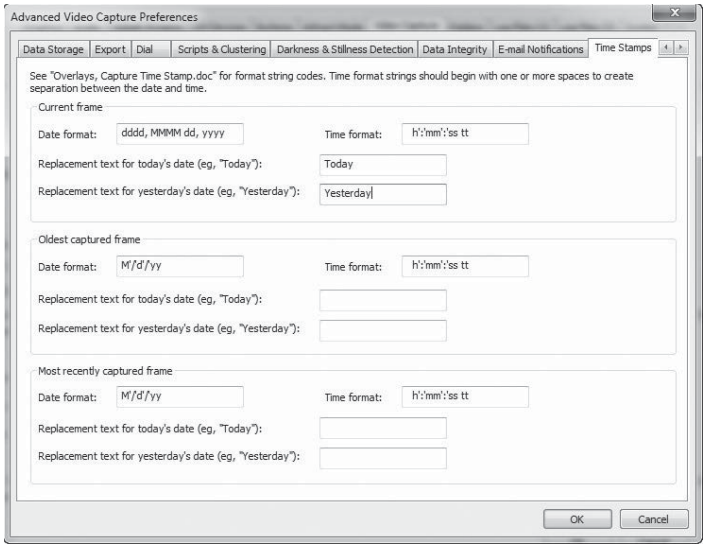


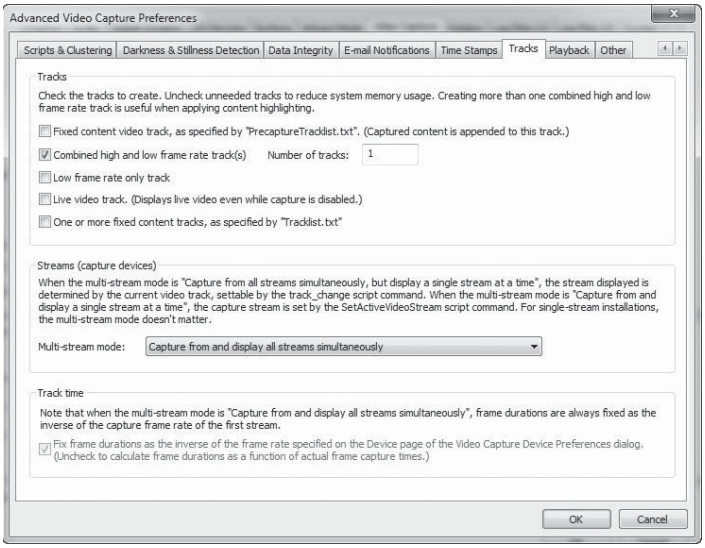


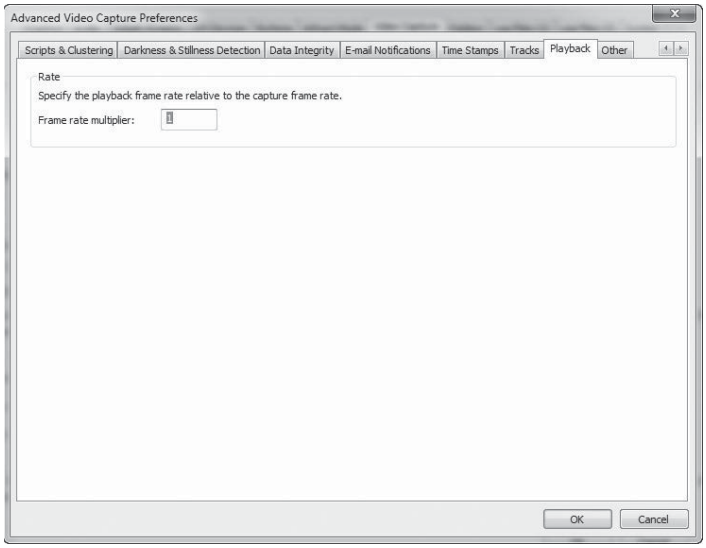


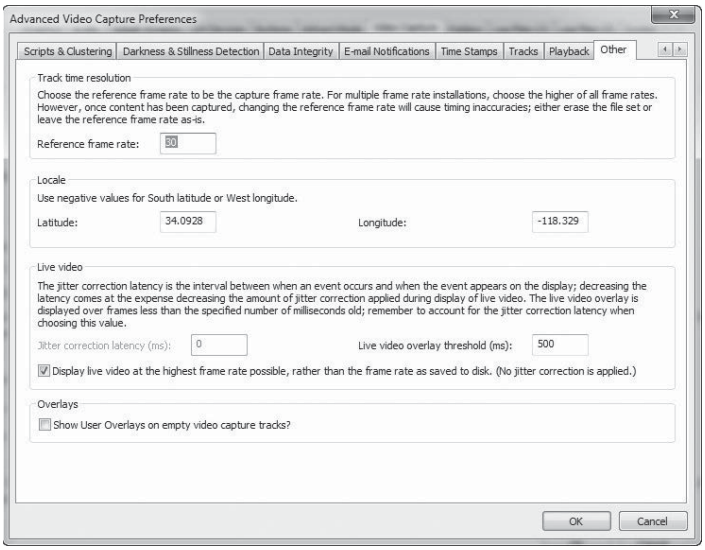
(Video Capture GUI - Advanced, Continued.)

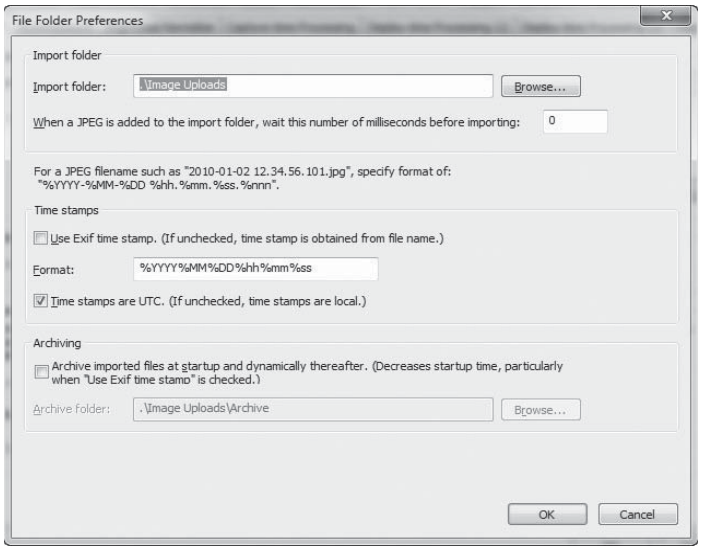




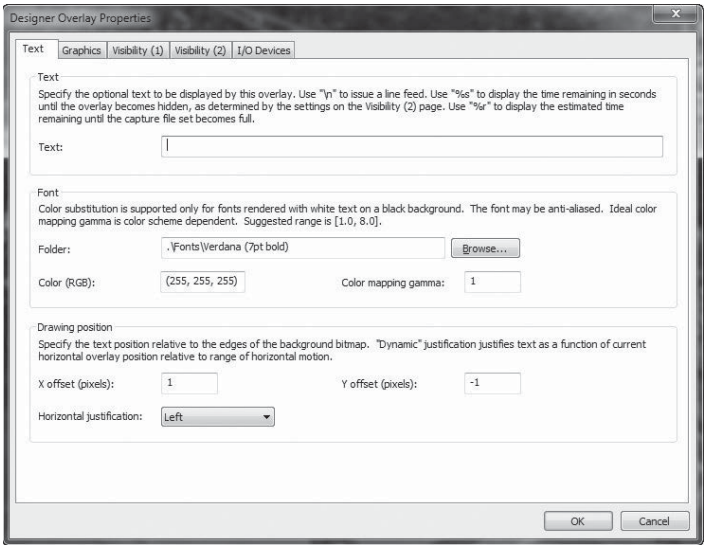


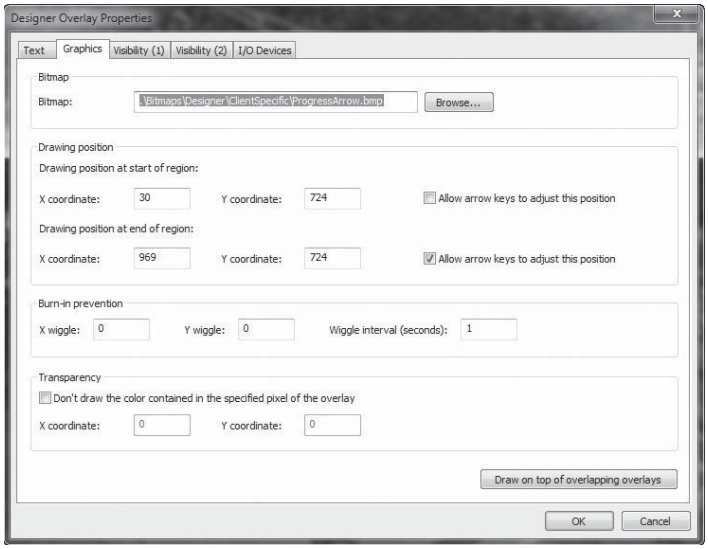


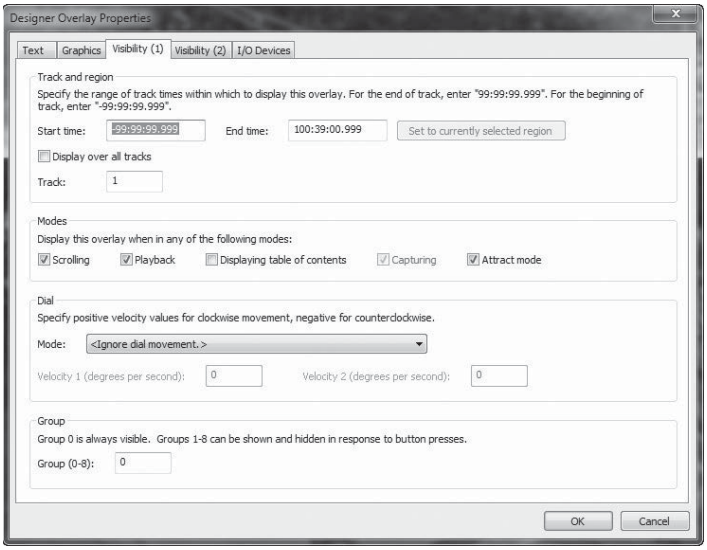


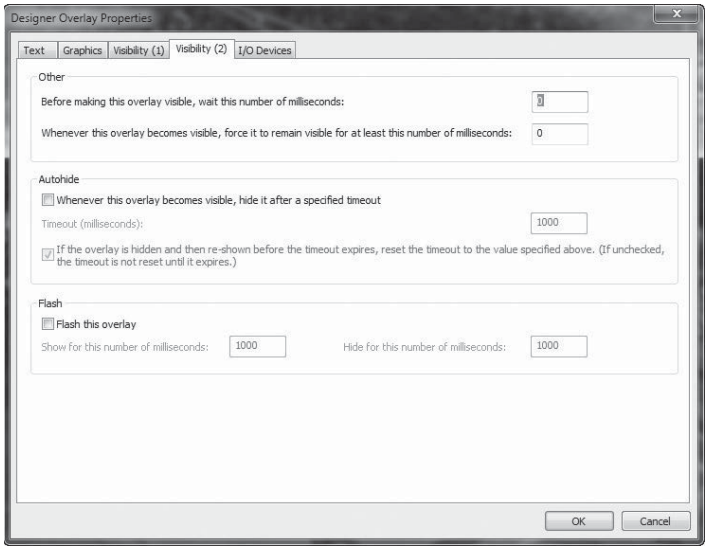


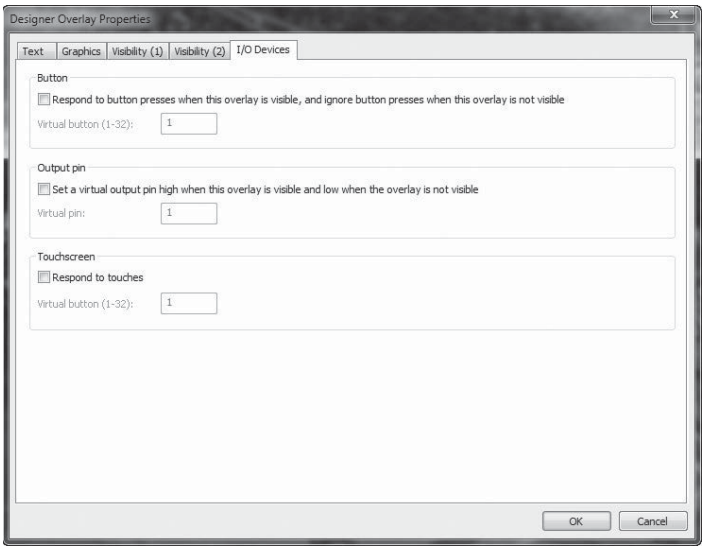
(Overlay - Graphics & Audio - GUI.)











More follows....

(Example Script File.)

```
;This script executes when the DROP button is pressed, releasing simulated asteroid demonstrating high speed water impact event.

;The overlays we need to display are associated with the attract track, not the capture track.  Switch to the attract track.
0           track_change        absolute  2           00:00:00.000

;Hide the "Press the DROP button..." overlays and turn off the drop button LED.
0           button    showoverlaygroup1           off

;Show the "Recording..." overlay and turn on lamps.
0           button    showoverlaygroup2           on

;Enable looping capture and pause.  Change this value to adjust delay between  button press and DROP signal.
300         button    capture   on

;Enable DROP DONE signal.
0           button    enablebutton3     on

;Send the DROP signal.
250         button    setoutputpin3     on
0           button    setoutputpin3     off
```

Note that the FrameGlide environment's sophisticated high speed data filtering features and screens (for example, show only the bright red cars within an hour-long city drive-through in under 1 second, instantly sort images of the sky by ascending temperature, etc.) are *not* shown here.

For additional information on such topics, visit our in-process beta site at http://www.temporalinnovations.com, and/or contact us for a live remote-access on-screen demo.

(END)