This process can be applied to non-optical two-dimensional images such as medical ultrasound and CAT scans. It also can be included as an option into thermography, X-ray systems, and microwave imaging systems. Essentially, SeDDaRA can be applied to any image system in which an impulse response is spread over several pixels.

Signal Processing

There are many cases where signals, electric or otherwise, suffer degradation from various sources. This algorithm has potential to improve signal reception for a wide variety of instrumentation. Frequencies, particularly those at the higher end of the desired spectrum, can be enhanced to give a received signal that is closer to the original.

For research, the algorithm could be embedded into digital oscilloscopes and other meters alongside more standard analysis features. The process-could be potentially be performed in near real-time or on 'snapshots' of signals. The algorithm can be added into laboratory software packages.

Communications can be enhanced in at least two ways. Signals degraded by long-distance communications can be recovered. Also, a signal can be intentionally compressed using a known α. This compression would allow information to be sent faster. The signal is then deconvolved upon reception.

Sound Recording

This process can be used to optimize sound recording and playback systems. Blind deconvolution processing can restore acoustic frequencies that have been degraded by the sound recording and playback systems.

There is also potential for restoring data by intentionally degrading the data a second time. For example, a bassoonist is making a recording in a small room. The sound is converted to an electrical signal by the microphone. That electric signal is converted to information on a magnetic tape. For playback, the information on the magnetic tape is converted back to an electric signal. The signal is amplified and transformed back into a sound wave by the speaker system. The transformation of the energy puts a certain level of degradation into the signal, depending on the quality of the system.

To remove the degradation, the bassoonist can play the recording through the speaker system, and record it a second time through the microphone. The second recording will have twice the degradation as the first. As stated earlier, the algorithm can compare a 'truth' signal to a degraded one to find the degradation. The important aspect is that there is a difference of one degradation between the images. Therefore, by comparing a signal with one level of degradation to a signal that has twice the degradation, the form of the degradation can be removed using the same process outlined above. Using a deconvolution process, the degradation is then removed from the first recorded signal.

SeDDaRA may have commercial application in the recording industry. To date, sound systems improve their quality by developing better electronics to reduce the degradations. Through signal processing, future systems can remove any remaining degradations. One can foresee having selections of whether the home sound system should replicate a chamber room or a symphony hall sound, with the processing taking place inside the stereo system.

Embedded Electronics

Computer processors are continually being built faster, cheaper, smaller, and more energy efficient. Specific processors are being manufactured for digital phones. The sound quality of the phone can be enhanced by embedding the algorithm into the phone to correct for degradations that occur in the microphone, transmitter, receiver, and speaker. Processors could eventually find their way into hearing aids. This code can be implemented, either as software or hardware, into the hearing aid to correct for the narrow reception cone and system electronics. With a fast enough processor, the person would not be able to sense the time difference.

Conclusions, Ramifications, and Scope

The SeDDaRA process has several unique characteristics that are not found in current signal processing algorithms. At the core of the process, the application of this method extracts a reasonably good approximation for the degradation of a signal in a comparatively short amount of time. This algorithm is easy to implement, and can be inserted into existing signal processing packages without much difficulty. As demonstrated, the method works well on a wide variety of signal types, including imagery, acoustic waveforms, and any signal that suffers from significant low-pass filtering. All this is accomplished without direct information about the type of aberration, or the severity.

Potential commercial applications include image processing, for both research-based and consumer-based imagery. Aging photographs and movies may be restored and preserved digitally, or reprinted. Non-optical images such as medical ultrasound scans and X-rays scan can also be improved. This technique can be a valuable research tool to recover the full bandwidth of a signal, preserving critical high-frequency data. SeDDaRA may find application in recording studios and home sound systems to counteract effects created by room acoustics, and enhance the quality of the reproduction. With the advent of small powerful processors, this algorithm may be embedded into personal devices such as hearing aids, and cell phones to enhance performance.

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