neighborhood is due to practical computational constraints in some cases. In addition, some of these methods like median and other non-linear filtering are inherently incapable of meaningfully using the global information.

Typically the presence of scratch noise appears as a sudden variation in the pixel intensities at the scratch locations when compared with the surrounding pixel intensity values. This sudden variation appears as high frequency components in the frequency spectrum of a image. By removing higher frequency components, variation in pixel intensity can be reduced to thereby lessen the visibility of the scratch area within the image frame. This operation is known as low-pass filtering and involves transforming the image from the spatial (or image) domain into the frequency domain, filtering out a predetermined level of high frequency components and transforming the resulting image frequencies back into an image. Similar results can be achieved via an operation known as a convolution, which operates on the image directly without first converting it into the frequency domain. Low pass filtering is effective in reducing scratch noise from certain types of images, typically images having few details or smooth textures. This technique is not, however, effective for removing scratch noise from images having textures or very detailed areas or prominent edges. Smoothing by low-pass and similar linear filtering techniques, whereby variations in pixel intensities within a given area are averaged out, is not effective since it often results in reconstructed, or repaired, scratch noise areas being blurred and loss of detail in the repaired scratch area.

With median filtering techniques, a given pixel of a subject image is replaced with the median value of the surrounding pixels. Which pixels comprise the surrounding pixels of a pixel at issue is typically defined by specifying the limits of a window enclosing that pixel. For example a window of 10 pixels by 10 pixels (10×10) in which the pixel at issue is located could be used to define the "surrounding" pixels. The surrounding pixels can also be referred to as the "neighborhood" of a given pixel. The size of the window or neighborhood can be varied in accordance with the needs at hand. In applying median filtering to scratch removal where the location of the scratch is known, only the scratch pixels will be replaced by the median value of the surrounding pixels.

Median and similar non-linear filtering techniques work relatively well where the scratch area is limited to a relatively small group of isolated pixels. Typically scratches, and particularly wire noise, consist of many contiguous pixels. As a result, the median value of surrounding pixels is typically the value of the scratch area itself. If a small window, or neighborhood, is chosen, scratches are typically not repaired, since the median value is typically the value of the scratch area itself. In other words, the scratch pixels values are replaced with the value of the scratch pixels. Where a larger window is chosen so as to provide a greater number of surrounding pixels, blurring of the image typically results .

In techniques based on statistical texture synthesis, an area of the damaged image at issue is analyzed and a statistical representation of the image area is developed. This statistical representation is then used to generate a synthesized texture that is similar to the analyzed area . Scratch/wire noise pixels can then be replaced with the synthesized texture. Statistical methods are based on the assumption that the relationship between pixels in a neighborhood has a statistical description which can be discovered by analysis. Thus a given pixel's characteristics are supposed to depend

statistically on some or all of its nearby pixels. Where there is a relationship between pixels which are relatively far apart in distance, the neighborhood necessary for analysis of those pixels must be relatively large. An example would be a brick wall with large bricks or a wide wire mesh photographed close-up. Typically in these methods the computational processing required increases as the number of pixels within the neighborhood on which a given pixel depends is increased. As a result these methods are not useful for textures having large features, such as, for example, the texture of an image of a typical brick wall.

Many popular image processing programs, such as for example, Adobe Photoshop™, provide a tool for copying pixels from one area of the image to another area. With these types of tools, the area of the image to be copied is typically selected, or defined, via use of a mouse, or other pointer/control device, which allows a user to manipulate a cursor or "brush" on the display screen which displays the image at issue. Using the mouse device, a source area from which pixel data is to be read, or transferred, is defined. Then a destination area to which the pixel data from the source area is to be transferred is defined. "Brush strokes", or movement of the cursor across the destination area, can be accomplished using the mouse. With each "brush stroke" pixels from the source area are copied to the destination area. This method works well when the texture, or pattern, depicted in the image at issue is random or regularly occurring in nature and has relatively small features. Small features might include, for example, spots on a piece of fruit, sand, asphalt of a road, or fabric weave. Where there are, for example, random or regularly occurring details, or patterns, depicted in the image in the form of curved or straight lines then alignment of the edges of the repaired region with that of the surrounding region is very time consuming. Repairing scratches or wires using rubber stamp painting is a task requiring lots of time and skill for many images. Since the human visual system is very sensitive to problems with edges, mismatched edges are relatively easy to pick out by the human eye.

Another technique for scratch removal has been to "paint" over the pixels of the scratch by manually matching the scratch pixels with the surrounding area. This method is very time consuming and the quality of the results obtained depends heavily on the skill of the operator. An even bigger problem is when the image has uneven intensity due to lighting conditions or inter reflections. In such cases, finding the same intensity source area can be difficult. With reference to FIGS. **6**(A) and **6**(B), such figures illustrate the problems resulting of the simple copying of when attempting to cover up noise in an image with non-uniform shading. Such copying can create misalignment and shading mismatch. In further detail, FIG. **6**(A) illustrates an example of noise to be removed or covered up and also illustrates the dotted line region to be copied to cover up such noise. FIG. **6**(B) illustrates that the dotted line region has been copied onto the noise. However, the resulting lines are misaligned, and as would be expected because of non-uniform shading, the color of the covered up area is different from that of the surrounding area.

Techniques of scratch noise removal based on projection methods in the context of signal restoration have been previously used. These methods have been used to extend the frequency spectrum of band-limited signals by alternating between signal and transform domains and applying constraints of each domain. The constraints are directed to preservation of known signal values and enforcement of bandlimits. This approach has been generalized through a