UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Karl Storz Endoscopy-America, Inc.
Petitioner

v.

Novadaq Technologies, Inc.
Patent Owner

U.S. Patent No. 7,420,151
Filed: October 10, 2006
Issued: September 2, 2008

Title: Device For Short Wavelength Visible Reflectance Endoscopy Using Broadband Illumination

PETITION FOR *INTER PARTIES* REVIEW OF U.S. PATENT NO. 7,420,151

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EXHIBIT LIST

Exhibit No.	Description
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1002	Prosecution History of U.S. Patent No. 7,420,151
1003	U.S. Patent No. 4,742,388 to Cooper ("Cooper")
1004	U.S. Patent No. 6,147,705 to Krauter ("Krauter")
1005	FICE Fuji Intelligent Chromo Endoscopy brochure ("FICE 2005 brochure")
1006	U.S. Patent No. 7,050,086 to Ozawa ("Ozawa")
1007	U.S. Patent No. 4,885,634 to Yabe ("Yabe")
1008	FICE Flexile spectral Imaging Color Enhancement brochure ("FICE 2008 brochure")
1009	March 30, 1999 Response to Office Action of the Krauter patent
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1011	Declaration of Erhan Gunday
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1013	4400 Electronic Video Endoscopy System ("EPX-4400 brochure")
1014	FICE Atlas of Spectral Endoscopic Images ("FICE Atlas")
1015	Development of New Electronic Endoscopes Using the Spectral Images of an Internal Organ ("FICE article")

Karl Storz Endoscopy-America, Inc. ("Petitioner") submits this Petition for *Inter Partes* Review of claims 1-17 (the "Challenged Claims") of U.S. Patent No. 7,420,151 (Ex. 1001) ("the '151 patent").

I. MANDATORY NOTICES

A. Real Party-in-Interest

Petitioner, Karl Storz Endoscopy-America, is a real party-in-interest. Karl Storz GmbH & Co. KG is also a real party-in-interest.

B. Related Matters

As of the filing of this petition, there are no judicial or administrative matters that would affect, or be affected by, a decision in an *inter parties* review for the '151 Patent.

C. Lead and Back-up Counsel Service Information

Petitioner provides the following designation of counsel.

Lead Counsel	**Back-up Counsel**
Wesley W. Whitmyer, Jr. (Reg. No. 33,558) WHITMYER IP GROUP LLC 600 Summer Street Stamford, CT 06901 Phone: (203) 703-0800 Fax: (203) 703-0801 litigation@whipgroup.com USPTO Customer No. 131672	Michael J. Kosma (Reg. No. 70,169) Michael A. Lavine (Reg. No. 69,917) WHITMYER IP GROUP LLC 600 Summer Street Stamford, CT 06901 Phone: (203) 703-0800 Fax: (203) 703-0801 mkosma@whipgroup.com mlavine@whipgroup.com USPTO Customer No. 131672

D. Service Information

This Petition is being served to the current correspondence address of record with the USPTO for the '151 patent, as provided below. This petition is also being served upon counsel of record for the Patent Owner in a trademark litigation pending before the U.S. District Court in the Northern District of California entitled *Novadaq Technologies, Inc. v. Karl Storz GmbH & Co. KG et al.*, Case No. 5:14-cv-04853-PSG (N.D. Cal.) as follows:

Julian D. Forman Novadaq Technologies Inc. 13155 Delf Place Unit #250 Richmond BC V6V 2A2	Jennifer Lee Taylor MORRISON & FOERSTER LLP 425 Market Street San Francisco, California 94105-2482 JTaylor@mofo.com

The Petitioner may be served at the addresses provided above for lead and back-up counsel, and consents to electronic service at those addresses.

E. Power of Attorney

Filed concurrently in accordance with 37 C.F.R. § 42.10(b).

II. PAYMENT OF FEES

Review of seventeen (17) claims is requested. The required fee is paid through online credit card payment. The United States Patent and Trademark Office is authorized to charge any fee deficiency, or credit any overpayment, to Deposit Account No. 50-6749.

III. REQUIREMENTS FOR INTER PARTES REVIEW UNDER 37 C.F.R. §§ 42.104 AND 42.108

A. Grounds for Standing

Petitioner certifies that the '151 Patent is available for *inter parties* review and that the Petitioner is not barred or otherwise estopped from requesting *inter parties* review of the Challenged Claims on the grounds identified herein. Petitioner certifies: (1) Petitioner is not the owner of the '151 patent; (2) Petitioner (or any real party-in-interest) has not filed a civil action challenging the validity of the Challenged Claims; (3) Petitioner has not been served with a complaint alleging infringement of the '151 patent, and neither has any real party-in-interest or privy of Petitioner; (4) the estoppel provisions of 35 U.S.C. § 315(e)(1) do not prohibit this *inter partes* review; and (5) this Petition is filed more than nine (9) months after the '151 patent was granted. Petitioner is unaware of any previous petition for *inter partes* review or request for reexamination with respect to the 151 patent.

B. Identification of Challenges Under 37 C.F.R. §§ 42.104(b) and Statement of Precise Relief Requested

Petitioner respectfully requests that the Board initiate *inter partes* review of claims 1-17 of the '151 patent. This Petition cites the following prior art references, included as Exhibits **1003** through **1007**.

Exhibit No.	Description of Prior Art Reference
1003	U.S. Patent No. 4,742,388 to Cooper ("Cooper"), filed on May 18, 1984, was published at least as early as its issue date, May 3, 1988, and is therefore prior art under 35 U.S.C. § 102(b)
1004	U.S. Patent No. 6,147,705 to Krauter ("Krauter"), filed on August 20, 1996, was published at least as early as its issue date, November 14, 2000, and is therefore prior art under 35 U.S.C. § 102(b)
1005	FICE Fuji Intelligent Chromo Endoscopy brochure ("FICE brochure"), was published in September 2005, and is therefore prior art under 35 U.S.C. § 102(a)
1006	U.S. Patent No. 7,050,086 to Ozawa ("Ozawa"), filed on June 25, 2002, was published on December 26, 2002, and is therefore prior art under 35 U.S.C. § 102(b)

1007	U.S. Patent No. 4,885,634 to Yabe ("Yabe"), filed on August 1, 1988, was published at least as early as its issue date, December 5, 1989, and is therefore prior art under 35 U.S.C. § 102(b)

As explained in section III.B above, each reference listed above qualifies as prior art to the '151 patent. This Petition is based on the following grounds:

Ground	**Claim(s)**	**Basis for Challenge**
1	1-17	Obvious over Yabe in view of the knowledge of one of ordinary skill in the, under 35 U.S.C. § 103(a)
2	1, 10, 11,13	Anticipated by Cooper under 35 U.S.C. § 102(b)
3	1, 7, 10, 12, 14	Anticipated by Krauter under 35 U.S.C. § 102(b)
4	1, 2, 10, 13	Anticipated by FICE under 35 U.S.C. § 102 (a)
5	1, 10, 11, 13 15-17	Anticipated by Ozawa under 35 U.S.C. § 102(b)

Section VII below provides a detailed explanation as to why claims 1-17 are unpatentable based on the grounds identified above. Additional explanation and support for this IPR and each ground identified above is set forth in the Declaration of Erhan Gunday ("Gunday") (Exhibit 1011), a technical expert with extensive experience in computer engineering (including hardware engineering), software, and medical imaging systems. (Gunday at Section II; Ex. 1012.)

C. Requirements for *Inter Partes* Review

The Board should institute *inter partes* review of claims 1-17 because this Petition establishes a reasonable likelihood of prevailing. As explained in section VII, each limitation of claims 1-17 is disclosed and/or suggested by the prior art such that each claim is unpatentable.

IV. BRIEF BACKGROUND OF THE UNDERLYING TECHNOLOGY

This section will provide a brief background of the state of the art pertinent to a person of ordinary skill in the art as of October 17, 2005, the filing date of U.S. Provisional Application No. 60/727,479, to which the '151 Patent claims benefit. (Gunday at Section IV.A.)[1]

A. Endoscopes

Endoscopes were widely known and used in the art long before the alleged priority date of the '151 patent. They were used in both diagnostic and therapeutic medical procedures to illuminate objects inside the human body and carry the reflected light back to the observer. There are basically two types of endoscopes – rigid and flexible – which come in a variety of lengths, and diameters. Endoscopes typically included image sensors located at the distal or proximal ends of the scope. (Gunday at IV.A.1.)

B. Light Sources

Light sources, including broadband light sources, were not new at the as of the alleged priority date of the '151 patent. Broadband light (also known as "white

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[1] As explained by Mr. Gunday, a person of ordinary skill in the art for purposes of the '151 patent would have had at least a Bachelor of Science degree in Physics, Computer Engineering, Computer Science, or other similar degree, and two (1) to three (3) years of work experience relating to medical imaging. Such a person would have had an understanding of, or experience in, designing, implementing, and using endoscopic imaging systems, including light sources and endoscopic video and image processing. (Gunday at ¶¶ 72-77.)

light") is light that includes wavelengths from the full spectrum of visible light, which is approximately 400 nm – 700 nm. Before the '151 patent's invention, broadband light sources such as the following were widely used in endoscopic systems: halogen lamps, metal halide lamps, and xenon arc lamps. (Gunday at ¶¶ 30-32.) Techniques for using broadband illumination light to create white light images (also known as True Color, original, RGB, convention, or full-spectrum images) and short wavelength images (i.e. images comprising light having short wavelengths lights as blue light (approximately 470 nm) were also known in the art at the time of the '151 patent's alleged priority date. (Gunday at ¶¶33-37.)

C. Image Sensors

Image sensors (or "imagers") were also widely known and used in the relevant art before the alleged priority date of the '151 patent. Such image sensors included charge couple devices (CCDs), complementary metal oxide semiconductor devices (CMOS), and camera tubes. The CCD's comprised pixels (also known as cells) that accumulate charge in proportion to the number of photons (i.e. light particles) that enters the pixel, and the accumulated charges in those cells are read out sequentially and cyclically via electronic circuits to produce a raw analog video signal. (Gunday at ¶¶ 38-40.) CCD's came in various configurations (e.g. with differing numbers of pixels and overall CCD size). They were also were inherently "black and white" image sensors, meaning that the pixels were sensitive (i.e. responsive) to all photons. (*Id.* at ¶¶41-42.) In the relevant art, a Color CCD image sensor included a black and white CCD image with one or more color filters (e.g. a rotary color filter or a color filter array) positioned in the part of light that is directed to the CCD's pixels. Those color filters allow only certain wavelengths of light (i.e. colors) to pass through to the CCD's pixels. (*Id.* at ¶ 42.)

The filters that were typically used in Color CCD image sensors included the well-known rotary RGB color filters, or Bayer pattern RGB filters, which allowed only red, green, or blue light to pass through to the CCD. (*Id.* at ¶¶43.) CMYG filters were also typically used, and allowed only Cyan, Magenta, Yellow, or Green light to pass through to the CCD. (*Id.*) Other types of CCD systems were used to create color images, including 3CCD systems. (Gunday at ¶¶48.)

Each CCD pixel would receive primarily (or mostly) the wavelength of light corresponding to the color of the filter that is positioned directly in the path of light that is ultimately directed to the pixel. For example, in the case of a Bayer pattern RGB color filter, a pixel positioned directly under a red part of the filter would receive primarily red light, and possibly a small amount of green and/or blue light via nearby green or blue parts of the filter. This way, a given CCD pixel in a color image sensor is responsive primarily to the wavelengths of one or more given colors, depending on the type of color filter being used. (Gunday at ¶¶ 42-49.)

D. Image Signal Processing

Prior to the alleged priority date of the '151 patent, regardless of whether an image signal is created using an RGB, CMYG, or other type of color image sensor, the image signal could be processed to amplify, suppress, or eliminate one or more colors from the image. The processing steps included pre-processing (including analog to digital conversion), memory use to store image data, image processing (including white balancing, color correction, and hue processing). (*Id.* at ¶¶50-56.) These processes were typically performed using processing matrices, which were known and used commonly in the art, and could be implemented in any conventional endoscopic video processor, an FGPA, or a DSP (Digital Signal Processor). (*Id.* at ¶¶53-56.) The matrices were typically used, for example, to calculate the red, green, and blue components of image signals that were received by the CCD. The matrix coefficients were typically modified for use in the above-mentioned processing steps, (e.g. color correction), and could also be used to eliminate the contribution of a given color of light from an image being displayed. (*Id.*) Such routine modification allowed endoscopic uses to obtain the most optimal image characteristics for endoscopic examination.

E. Color Displays Used In Medical Endoscopic Systems

Color display monitors were highly prevalent in the art before the '151 patent's priority date, and included CRT's (cathode ray tubes) and flat panel displays such as Liquid Crystal Displays (LCDs). These displays typically had a variety of video inputs including RGB inputs, Y/C (luminance/chrominance) inputs, and Composite inputs. Display monitors are inherently RGB devices, comprise an array of small elements (called display pixels) that emit light when energized. (*Id.* at ¶¶57-61.)

V. SUMMRARY OF THE CLAIMED SUBJECT MATTER

A. Introduction

Against the backdrop of the above-discussed technology background, it is evident that the ‘151 patent does nothing more than use endoscopic system components and commonly known imaging techniques that were known in the art to generate and display images having different colors, different color combinations, or different amounts of color.

B. The ‘151 Patent Specification

The ‘151 Patent is directed to a system for performing short wavelength imaging with a broadband illumination source. (Ex. 1001 at 3:3-13, 30-36.) The system includes an image processor which reduces the contribution of red illumination light to an image by computing blue, green and blue-green (cyan) color components of display pixels from the signals received from an image sensor. (*Id.* at 4:12-27). The blue, green and cyan color component values are coupled to inputs of a color monitor for display to produce a false color image of the tissue. (*Id.* at Abstract.)

The ‘151 patent admits that techniques for generating images from a subset of visible wavelengths, in particular from short blue and green wavelengths, were already known in the art. (*Id.* at 1:29-53.) The ‘151 patent also admits that it was already known in the art that such techniques involved the use of specialized endoscopic light sources that are equipment with one or more filters to restrict the spectrum of illumination light to light in the blue-green wavelength band. (*Id.* at

1:44-53.) Additionally, the '151 patent admits that color image sensors that may be used in a video endoscope system for performing short wavelength imaging with a broadband illumination source were already known in the art. (*Id.* at 3:37-67; Fig. 2A-2B.) Next, the '151 patent admits that image processors for providing the necessary image processing speed and memory, "such as the 6400 series of processors from Texas Instruments Corp." were already known in the art. (*Id.* at 8:5 – 25.)

But the '151 patent criticizes these known techniques and technology as requiring filters that are "generally incorporated into a mechanism which moves them into and out of the light path and thereby increases the cost and complexity of the light source" because physicians often want to utilize both the full spectrum of white light and the restricted blue-green spectrum. (*Id.* at 1:48-53.) According to the '151 patent, this increases the cost and complexity of the light source. (*Id.*)

The '151 patent proposes to improve on the prior art by providing an endoscopic imaging system that does not require the incorporation and movement of filters to produce the light for the two different imaging modes, but still allows physicians to utilize the same light source for a full spectrum white light imaging mode and a restricted spectrum, short wavelength imaging more." (*Id.* at 1:53-59.)

Fig. 2C (below), attempts to show the basic operation described in the '151 patent whereby the contribution of red illumination light to an image is reduced by computing blue ("B"), green ("G") and blue-green ("B" and "G", i.e. cyan) color components of display pixels from the signals received from an image sensor. (*Id.*

at Fig. 2C; 4:12-42.) The '151 patent does not provide much detail regarding image processing except to say that color is calculated and several remaining details are left for "individual preference." (*Id.* at 4:28-32; Gunday at ¶¶65-67.)

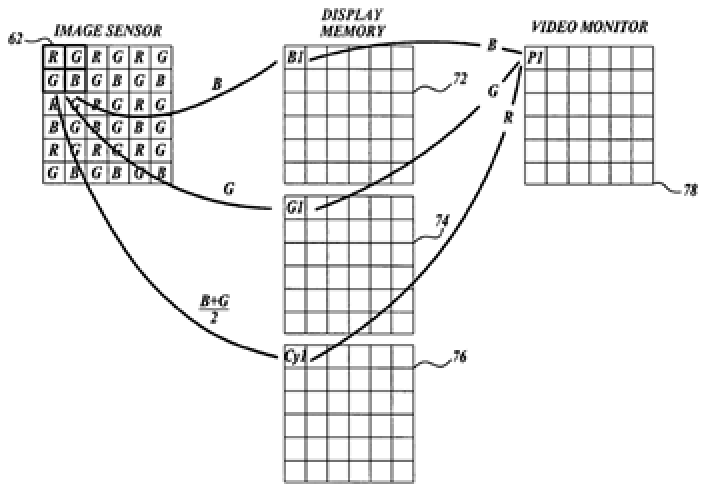


Fig.2C.

C. The Challenged Claims of the '151 Patent

This Petition addresses the two independent claims of the '151 patent (claims 1 and 10), and dependent claims 2-9 and 11-17. Independent claim 1 is representative, and recites:

> 1. A system for producing images of tissue with a medical device that delivers an illumination light to a body cavity and a color image sensor that produces images of the tissue from a number of pixels that are sensitive to different wavelengths of light, comprising:
>
> an image processor coupled to receive signals produced by the color image sensor in response to illumination light reflected

> from the tissue having red, green, and blue color components, wherein, the image processor calculates image signals that are stored in a memory by minimizing the contribution from signals produced by the image sensor in response to red illumination light.

(*Id.* at 9:3-14, Claim 1.) Independent claim 10 recites a substantially similar system. (*Id.* at 10:12-29.) Dependent claims 2-9 all ultimately depend from claim 1. Dependent claims 11-17 all ultimately depend from claim 10.

VI. CLAIM CONSTRUCTION

"A claim in an unexpired patent shall be given its broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b). Claim terms are given their ordinary and accustomed meaning as would be understood by one of ordinary skill in the art, unless the inventor, as a lexicographer, has set forth a special meaning for a term. *Multiform Desiccants, Inc. v. Medzam, Ltd.*, 133 F.3d 1473, 1477 (Fed. Cir. 1998); *York Prods., Inc. v. Central Tractor Farm & Family Ctr.*, 99 F.3d 1568, 1572 (Fed. Cir. 1996).

A. "color image sensor"

Independent claim 1 recites the term "color image sensor." As explained below, the broadest reasonable interpretation of "color image sensor" is "*an arrangement comprising an image sensor and at least one color filter, where the image sensor's pixels receive light that passes through the color filter*." (Gunday at Section VI.A.)

Petitioner's proposed construction is consistent with the language of the claims. For example, according to claim 1 the color image sensor "produces images…from a number of pixels that are sensitive to different wavelengths of light." (Ex. 1001 at Claim 1.) Also, various types of color image sensors were known in the art at the time of the '151 patent's invention, including RGB (rotary filter) sensors, RGB (Bayer mosaic filter) sensors, CMYG sensors, and 3CCD sensors. (Gunday at ¶¶42-49.) These color image sensors comprised an image sensor having pixels that generated color image data based on the color of light that they received though a color filter. (*Id.* at ¶¶42-49, Section VI.A.)

Next, the '151 patent specification does not provide any specific definition for "color image sensor," but provides examples of known color image sensors including a "CMYG color image sensor" (Fig. 4), and an "RGB color image sensor" (Fig. 2A). (Ex. 1001 at Figs. 2A and 4, 2:8-19, 3:16-22l Gunday at ¶¶ 38-49.) Independent claim 1, however, does not limit the term "color image sensor" to RGB-type color image sensors, CMYG-type color image sensors, or any other particular type of image sensor. This is evident from the language of Dependent claim 2, which depends from claim 1 and requires the color image sensor to be an "RGB sensor," and dependent claim 7, which also depends from claim 1 and requires the color image sensor to be a "CMYG" sensor.

As such, the term "color image sensor" in claim 1 must be defined broadly enough to include conventional RGB and CYMG image sensors, but should not be limited to just those types of sensors. And since the term "color image sensor" is not given a special meaning in the specification, it should be given its ordinary and accustomed meaning as would be understood by one of ordinary skill in the art. (Gunday at VI.A.) Therefore, the broadest reasonable interpretation of "color image sensor" is: "*an arrangement comprising an image sensor and at least one color filter, where the image sensor's pixels receive light that passes through the color filter*." (*Id.*)

B. "RGB sensor"

Dependent claims 2 and 13 each recite the term "RGB sensor." As discussed above, RGB-type sensors were well known in the art and included arrangements of rotary RGB filters and CCD image sensors, as well as RGB mosaic filters (including Bayer pattern mosaic filters) connected to or overlaying CCD sensors. (Gunday at ¶¶38-49.) The '151 patent provides an example of an RGB sensor, but nothing in the language of the claims or in the specification describes RGB color sensors in a manner different from the understanding of one of ordinary skill in the art. (Gunday at VI.B.)

Therefore, the broadest reasonable interpretation of RGB sensor is "*an arrangement comprising an image sensor and at least one color filter, where the image sensor's pixels receive light that passes through the color filter*." (*Id.*)

C. "CMYG sensor"

Dependent claims 7 and 14 recite the term "CMYG sensor." As discussed above, CMYG-type sensors were well known in the art at the time of the '151 patent's invention. (Gunday at ¶¶38-49.) The '151 patent provides an example of a CMYG sensor, but nothing in the language of the claims or in the specification describes CMYG color sensors in a manner different from the understanding of one of ordinary skill in the art. (Gunday at VI.C.)

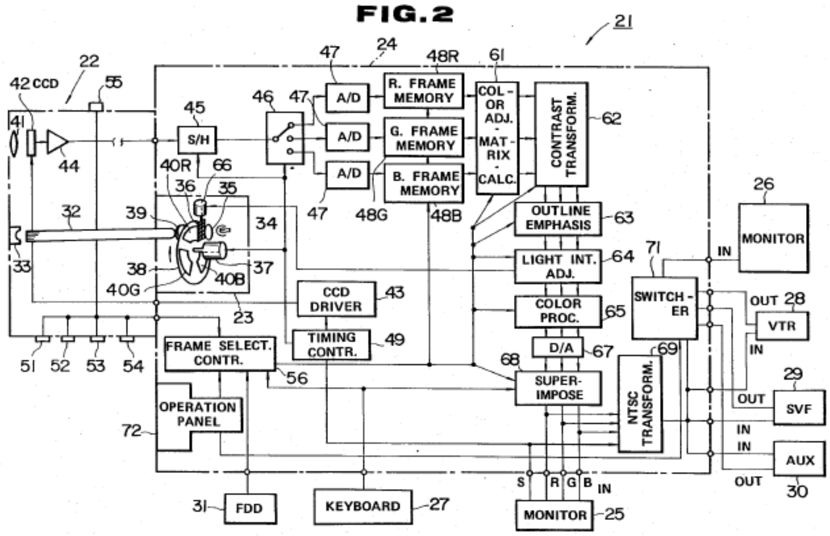
Therefore, the broadest reasonable interpretation of CMYG sensor is *an arrangement comprising an image sensor and cyan, magenta, yellow, and green color filters, where the image sensor's pixels receive cyan, magenta, yellow or green light that passes through the color filter*." (*Id.*)

VII. CLAIMS 1-17 OF THE '151 PATENT ARE UNPATENTABLE

A. Ground 1: Claims 1-17 Are Obvious Over Yabe In View Of The Knowledge Of A Person Of Ordinary Skill In The Art (POSITA)

Each and every limitation of each of the Challenged Claims is taught by Yabe in combination with the knowledge of a POSITA. Petitioner's obviousness analysis of Yabe is relies primarily on Yabe's <u>second embodiment</u>, which is represented by Figure 2 below. (Ex. 1007 at Fig. 2.)

FIG.2



As discussed below and in the Declaration of Erhan Gunday, to the extent that Yabe's second embodiment does not disclose a given element in claims 1-17, that element would have been obvious in view of Yabe's first and/or third embodiments and the knowledge of a POSITA. (Gunday at ¶¶ 116-17, 137-40, 143-44, 147-50, 153-54, 158, 161-65, 168-69, 172, 182-83, 199, 202, 206, 209, 212-215, 218, 221-24].)

1. Independent Claim 1

First, Yabe discloses "*[a] system for producing images of tissue*" as recited by claim 1. This includes an "endoscopic apparatus" that enables the display of images having specific wavelength components and full color images, to substantially improve diagnostic functions. (Ex. 1007 at 1:11-16, 1:65-2:29, Fig. 2; Gunday at ¶¶111-13.) Yabe's endoscope apparatus is "*a medical device that delivers an illumination light to a body cavity*" as recited by claim 1. The endoscope includes a "light source section" that provides "illuminating lights of the wavelengths regions of red, green, and blue" to the subject that is under endoscopic examination. (*Id.* at 5:25-29, 5:40-53, 5:54-63, Fig. 2, Gunday at ¶¶111-13.

Second, the endoscope apparatus also has "*a color image sensor that produces images of the tissue from a number of pixels that are sensitive to different wavelengths of light*" as recited by claim 1. The *color image sensor* comprises the light source section's rotary filter which has "[a] fan-shaped red-transmission filter 40R, green-transmission filter 40G and a blue-transmission filter 40B mounted on said rotary filter 38," and the "CCD 42" that receives the red, green, and blue illuminating light that is reflected from the subject. (Ex. 1007 at 5:40-53, 5:54-63, 5:64-6:5; Gunday at ¶¶114-15.) The CCD of Yabe's color image sensor has an "image-pickup surface" that inherently comprises *a number pixels that are sensitive to different wavelengths of light*, and one of ordinary skill in the art would understand as such. (Ex. 1007 at 5:64-6:5; Gunday at ¶¶ 38-49, 114-15.) Yabe's color image sensor *produces images of the tissue from* those pixels because "[t]he image of the subject thus illuminated by the illuminating light . . . is formed on the image-pickup surface of a CCD 42 by. . . . This CCD 42 effects photoelectric conversion of an optical image and stores it as a signal charge [.]" (Ex. 1007 at 5:64-6:5; Gunday at ¶¶114-15.)

Third, Yabe discloses that its endoscopic apparatus also comprises "*an image processor coupled to receive signals produced by the color image sensor in response to illumination light reflected from the tissue having red, green, and blue color components*" as recited by claim 1. The "*image processor*" is the "video processor 24," and "through a signal cable" it receives the "signal charge" that were created and stored by the CCD 42 in response to the red, green, and blue illuminating light that was reflected from the subject. (Ex. 1007 6:1-11, 6:65-7:1, at Fig. 2 (showing CCD 42 coupled to video processor 24); Gunday at ¶¶118-120.)

Fourth, Yabe discloses that "*the image processor calculates image signals that are stored in a memory by minimizing the contribution from signals produced by the image sensor in response to red illumination light*" as recited by claim 1.

Yabe's video processor 24 stores the image signals received from the CCD 42 "in R, G, and B frame memories 48R, 48G, and 48B" and those signals are then "input into a color adjustment/matrix/calculation circuit 61," after which they undergo various other transformation and processing steps including before ultimately being output to monitors 25 and 26. (Ex. 1007 at 6:65-7:31, 8:36-12:60; Fig. 2; Gunday at ¶¶121-28.)

Image signals are calculated in Yabe's "color adjustment/matrix/calculation circuit 61." (*Id.*) The calculated signals are referred to as the output signals "Roi", "Goi" and "Boi." (Ex. 1007 at 11:52-56, Table 1.2; Gunday at ¶¶124-25.) Circuit 61 calculates these signals using various "set values" C_1 to C_{13} (i.e. constants) and the red (Rii), green (Gii), and blue (Bii) components of the image signals that were produced by, and subsequently received from, the CCD 42. (Ex. 1007 at 10:55-59, Table 1.2; Gunday at ¶¶123-25.) "[T]he set values of C_1 to C_{13} are input through the keyboard 27 according to the kind of principal disease concerned and the region of interest to be examined." (Ex. 1007 at 14:7-20.) Yabe discloses that its endoscopic apparatus can operate in several modes including a "G+B" mode, which "is effective for endoscope examinations using different shades of blue." (Ex. 1007 at 12:62-66.) In the "G+B" mode, the video processor's circuit 61 *"minimiz[es] the contribution from signals produced by the image sensor in response to red illumination light"* as required by claim 1 by calculating RGB-output signals (Roi, Goi, and Boi) using only the green (Gii) and blue (Bii) light components received from the CCD 42. (*Id.* at 14:5-20, Table 1.2;

Gunday at ¶¶126.) In other words, the contribution of red input Rii is eliminated from those calculations. Table 1.2, which "show[s] the RGB-output signals (Roi, Goi, and Boi) from the color adjustment/matrix/calculation circuit 61" is

TABLE 1.2

	Set mode		
Set mode	NORMAL	B/W	COLORING
G + B mode	Roi = 0	Roi = 0.3 C_6 (Gii + C_7 Bii)	Roi = 0.3 C_6 (Gii + C_7 Bii)
	Goi = Gii	Goi = 0.59 C_6 (Gii + C_7 Bii)	Goi = 0.59 C_6 (Gii + C_7 Bii)
	Boi = Bii	Boi = 0.11 C_6 (Gii + C_7 Bii)	Boi = 0.11 C_6 (Gii + C_7 Bii)
R + B mode	Roi = Rii	Roi = 0.3 C_8 (Gii + C_9 Bii)	Roi = 0.3 C_8 (Gii + C_9 Bii)
	Goi = 0	Goi = 0.59 C_8 (Gii + C_9 Bii)	Goi = 0.59 C_8 (Gii + C_9 Bii)
	Boi = Bii	Boi = 0.11 C_8 (Gii + C_9 Bii)	Boi = 0.11 C_8 (Gii + C_9 Bii)
R mode	Roi = Rii	Roi = 0.3 C_{10} Rii	Roi = 0.3 C_{10} Rii
	Goi = 0	Goi = 0.59 C_{10} Rii	Goi = 0.59 C_{10} Rii
	Boi = 0	Boi = 0.11 C_{10} Rii	Boi = 0.11 C_{10} Rii
G mode	Roi = 0	Roi = 0.3 C_{11} Gii	Roi = 0.3 C_{11} Gii
	Goi = Gii	Goi = 0.59 C_{11} Gii	Goi = 0.59 C_{11} Gii
	Boi = 0	Boi = 0.11 C_{11} Gii	Boi = 0.11 C_{11} Gii
B mode	Roi = 0	Roi = 0.3 C_{12} Bii	Roi = 0.3 C_{12} Bii
	Goi = 0	Goi = 0.59 C_{12} Bii	Goi = 0.59 C_{12} Bii
	Boi = Bii	Boi = 0.11 C_{12} Bii	Boi = 0.11 C_{12} Bii
Normal mode	Roi = Rii	Roi = 0.3(0.3 Rii + 0.59 Gii + 0.11 Bii)	Roi = Rii
	Goi = Gii	Goi = 0.59(0.3 Rii + 0.59 Gii + 0.11 Bii)	Goi = Gii
	Boi = Bii	Boi = 0.11(0.3 Rii + 0.59 Gii + 0.11 Bii)	Boi = Bii

reproduced below, with the "G+B" mode calculations highlighted for illustration. (Ex. 1007 at 14:15-20.)

Finally, Yabe discloses that the calculations image signals are stored in memory such as "a still video floppy apparatus (SVF) for picking up images, and other recording devices (AUX) 30 for recording/reproducing the composite video signals input to said monitor 26; and a floppy disk drive apparatus (FDD) 31." (Ex. 1007 at Fig. 2; 17:17:37-42; Gunday ¶ 127.)

Accordingly, Yabe discloses all elements of claim 1. However, to the extent that Yabe's rotary filter and CCD arrangement is not considered to be a color image sensor, it would have obvious to use either the conventional Bayer pattern RGB-type color image sensor or the conventional CMYG-type color sensor disclosed in the '151 patent, for example an arrangement where a RGB or CMYG mosaic color filter is attached to the CCD 42. (Gunday at ¶¶116-17.) Such types of color image sensors were well known in the art, and therefore it would have been a simple, common sense matter for a POSITA to incorporate one into Yabe's second embodiment. (Gunday Dec. at ¶¶43-46; 116-17.) A POSITA would be motivated to make this change because Yabe's states that the second embodiment can be applied to electronic scopes with "built-in color filters for image pickup" and Yabe's first embodiment includes such a scope. (Ex. 1007 at 6:44-49, 18:17-23; Gunday at ¶¶116-17.) In particular, the first embodiment's image sensor comprises a "color image pickup means which consists of a mosaic filter 17a in which color transmission filters of, for example, R, G, B are arranged. <u>This mosaic filter 17a is attached to the image pickup surface of the CCD 17</u>." (*Id.* at 3:25-34, Fig. 1.) It would be obvious to try the "image pickup means" of Yabe's first embodiment in the Yabe's second embodiment because it would serve the same purpose as the existing rotary filter/CCD arrangement and lead to predictable results (i.e. the generation of red, blue, and green image signals). (Gunday at ¶¶116-17, 128.) In sum, Claim 1 is obvious in view of Yabe and the knowledge of a POSITA.

2. Dependent Claim 2

Yabe also discloses "*wherein the image sensor is an RGB sensor having pixels that are primarily sensitive to red, green, and blue light*" as required by claim 2. (Gunday at ¶¶129-33.) As discussed above, the combination of the CCD 42 and the rotary filter (having red, green and blue transmission filters) in Yabe's second embodiment would be recognized as a type of RGB color filter. (*See also* Gunday at ¶¶130.) Alternatively, if would have been obvious for a POSITA to use a conventional RGB sensor with an attached mosaic in Yabe's second embodiment for the reasons discussed above in the discussion in claim 1. (*See also* Gunday at ¶¶130.) The '151 patent does not explain what it means for a pixel to be primarily sensitive to a given color of light, but a POSITA would consider any RGB image sensor's pixels to be inherently primarily sensitive to red, green, and blue light because each pixel receives primarily (or mostly) red, blue, or green light through the RGB filter. (Gunday Dec. at ¶¶131, 43.)

Yabe also discloses "*wherein the image processor receives signals from each of the sensor pixels and computes the image signals for storage in the memory <u>from the signals produced by the pixels that are sensitive to green and blue light only</u>*" as required by claim 2. This is disclosed, for example, by Table 1.2 in Yabe, which (as discussed above) shows that in the G+B mode, the red light component (Rii) is not used, and only the green and blue components (Gii and Bii) are used to calculate the RGB output signals Roi, Goi, and Boi. (Ex. 1007 at Table 1; Gunday at ¶¶132-33.) Therefore, claim 2 is obvious in view of Yabe and the knowledge of a POSITA.

3. Dependent Claim 3

Yabe discloses "*wherein the image processor computes signals to be stored in the memory by calculating a blue signal value from the signals produced by sensor pixels that are sensitive to blue light, a green signal value from the signals* *produced by sensor pixels that are sensitive to green light and the cyan signal value from a combination of the signals produced by sensor pixels that are sensitive to blue light and the signals produced by sensor pixels that are sensitive to green light*" as required by claim 3. For example, Yabe's Table 1.2 shows that in the "G+B" mode, for "NORMAL" the blue output signal is generated from only blue light components (Bii) and the green output signal is generated only from green light components (Gii). (Ex. 1007 at Table 1.2.)

Further, the RGB output signals for "B/W" and "COLORING" are all calculated using only green and blue components. (Ex. 1007 at Table 1.2 ("G+B mode").) As Claim 3 does not require the blue signals to be calculated exclusively from blue light or green light, the RGB output signal calculations in the G+B mode for "B/W" and "COLORING" meet this claim element with respect to the calculation of blue and green signals. (Gunday at ¶136.) If claim 3 is interpreted to require calculation of blue and green output signals exclusively from blue and green input signals, this is disclosed by the NORMAL calculations in the "G+B mode" as discussed above, as well by all calculations for the "G" mode (using exclusively Gii light components) and the "B" mode (using exclusively Bii components). (Ex. 1007 at Table 1.2.) A POSITA would have found it obvious to try using these alternative calculations to generate the blue and green output signals in the G+B mode because it would involve the simple substitution of known mathematical equations and also because it would help to enhance the diagnostic effectiveness of the endoscopic images. (Gunday at ¶¶136-37; Ex. 1007 at 12:61-66, 13:10-16.)

Next, it is well known in the art that cyan wavelengths are in the blue-green wavelength region of the visible spectrum. (Ex. 1001 at Abstract, 7:12-15; Gunday at ¶138.) Table 1.2 shows that in the "G+B mode," the B/W and COLORING calculations use combinations of green and blue light, and a POSITA would interpret these calculations as generating a cyan signal from the blue and green light. (Ex. 1007 at Table 1.2; Gunday at ¶139.) Further, it would have been obvious to try manipulating the constants C_6 and C_7 calculations to generate a cyan signal while in the G+B mode because doing so involves routine experimentation using a keyboard. (Gunday at ¶139; Ex. 1007 at 14:17-20.) A POSITA would be motivated to do so in order to obtain effective endoscopic examinations "according to the kind of the principal disease concerned and the region of interest to be examined." (Ex. 1007 at 12:62-66, 14:17-20; Gunday at ¶140.) Therefore, claim 3 is obvious in view of Yabe and the knowledge of a POSITA. (Gunday at ¶¶134-41.)

4. Dependent Claim 4

Yabe also discloses "*wherein the image processor <u>calculates the cyan signal</u> value to be stored in the memory <u>by averaging the signals produced by the pixels that are sensitive to blue light and green light</u>*" as required by claim 4. It would have been obvious to try averaging the Gii and Bii signals to calculate the RGB outputs in the G+B mode because it would involve manipulation of simple known mathematical equations and user-specified constants C_6 and C_7 to reach predicable results (i.e. the calculation of a blue-green (i.e. cyan) signal). (Ex. 1007 at Table 1.2, 14:17-20; Gunday at ¶¶142-44.) A POSITA would have been motivated to try averaging the signals as a means of simplifying the output signal calculations or to tailor the endoscopic images to better view and compare structures for the diseases or regions of human tissue concerned. (Ex. 1007 at Table 1.2, 14:17-20; *See also* Gunday at ¶¶143-45.) Also Table 1.1 provides additional motivation as many of its RGB-output signal calculations involve division. (Ex. 1007 at Table 1.1.) Therefore, Claim 4 is obvious in view of Yabe and the knowledge of a POSITA.

5. Dependent Claim 5

It would have been obvious for "the calculated blue signal value, green signal value and cyan signal value stored in the memory [to be] <u>supplied to separate color inputs of a color video monitor</u>" as required by claim 5. For example, Yabe second embodiment discloses an RGB typo monitor 25 "for displaying the video signals processed by the video processor" and the signals "are output to the monitor 25 through the RGB output terminals[.]" (Ex. 1007 at 7:22-25; Fig. 2.) Figure 2 shows that the RGB output terminals feed separately into the RGB monitor 25. (*Id.*; Gunday at ¶149.) Such RGB monitors were well known in the art to had separate red, green, and blue inputs. (Gunday at ¶¶57-58, 149.) It would have been obvious to try directing the cyan, green, and blue output signals respectively to the monitor's red, green, and blue inputs respectively because this involves the common sense use of known systems and functionality to direct a video signal to an RGB monitor's input with predictable results (i.e. the cyan, blue, and green signals would feed into the monitor). (Gunday at ¶150.) A POSITA would be motivated to do so to obtain effective endoscopic examinations in the "G+B" mode as taught by Yabe. (Ex. 1007 at 12:62-66; Gunday at ¶¶146-51.) Claim 5 is therefore obvious in view of Yabe and the knowledge of a POSITA.

6. Dependent Claim 6

It would have been obvious for "*the calculated blue signal value, <u>green signal value and cyan signal value</u> stored in the memory [to be] respectively supplied to blue, <u>red, and green</u> color inputs of the color video monitor*" as required by dependent claim 6. This variation would have been obvious to try because it would involve basic known techniques of re-routing of video signals to RGB monitor inputs using the video processor's existing functionality, with predictable results. (Gunday at ¶¶152-54.) A POSITA would be motivated to do such re-routing to obtain additional endoscopic image enhancements depending on the disease concerned or the region of interest being examined with the endoscope when in the "G+B", "G" or "B" mode. (Ex. 1007 at 12:62-66, 13:11-16, 14:8-20, Table. 1.2; Gunday at ¶¶153-55.) Therefore, claim 6 is obvious in view of Yabe and the knowledge of a POSITA.

7. Dependent Claim 7

It would have been obvious for "*the image sensor [to be] a CMYG sensor having pixels that are primarily sensitive to cyan, magenta, yellow, and green light, wherein the image processor computes luminance, red chroma difference and blue chroma difference values from CMYG pixel signals and converts the* *luminance, red chroma difference and blue chroma difference into blue, green, and cyan signal values and stores these signal values in the memory*" as required by claim 7. First, CMYG image sensors and their imaging functions were well known in the art as of the '151 patent's alleged priority date, and even the '151 patent admits this. (Ex. 1001 at 4:43-51; Gunday at ¶¶43, 156-57.) Also, the '151 patent does not explain what it means for a pixel to be primarily sensitive to cyan, magenta, yellow, and green light, but a POSITA would understand that the pixels of a CMYG sensor receive light primarily (or mostly) through a cyan, magenta, yellow, or green filter and therefore would primarily sensitive to such light. (Gunday at ¶158, 43.) Prior to the '151 patent's alleged priority date a POSITA would also have known, as the 151 patent admits, that the signals generated by a CMYG sensor were used to compute luminance, red chroma and blue chroma difference signals into display pixel values. (Ex. 1001 at 4:57-62, 4:66-6:59; Gunday at ¶¶159-60.)

It would have been obvious to use a CMYG sensor in Yabe's second embodiment because it would involve a simple substitution of one known type of image sensor for another to achieve the same predicable result (i.e. calculation of RGB-output signals). (Gunday at ¶161.) A POSITA would have been motivated to try this substitution because it is more common sense, simpler arrangement than the existing rotary filter/CCD arrangement in Yabe's second embodiment. (Gunday at ¶162.) Yabe also provides motivation for using a CMYG sensor because its third embodiment teaches the use of a color image sensor having a mosaic color filter where the filter units include the colors cyan (Cy), magenta (Mg), Yellow (Ye) and Green (G). (Ex. 1007 at 18:61-63, 19:1-10.) The CCD's outputs that are generated from the CMYG light components in the third embodiment are converted using a matrix "into R, G, B signals." (*Id.* at 19:34-37.) A POSITA would have found it obvious to try Yabe's third embodiment image sensor in Yabe's second embodiment as a simple, comment sense alternative that would lead to predictable results (calculation of RGB output signals). (Gunday at ¶163.)

As discussed above, it would have been obvious to use calculate a cyan signal using an RGB image sensor. It also would have been obvious to calculate the same cyan signal by using a CMYG image sensor, because it would be a matter of using the routinely-obtained luminance, red chroma differences, and blue chroma differences (discussed above), in addition to known matrix coefficients (typically provided by a manufacturer or obtained through routine experimentation) to calculate red, green, and cyan output signal values in the G+B mode of Yabe's second embodiment. (Gunday at ¶164.) A POSITA would be motivated to do this for Yabe's second embodiment in order to improve the diagnostic utility and functions of the endoscopic images in the "G+B" mode, for example. (Ex. 1007 at 12:64-66, 14:5-20, Table 1.2; Gunday at ¶165-66.) And as discussed above, Yabe discloses that its processed image signals are stored in memory. In sum, claim 7 is obvious in view of Yabe and the knowledge of a POSITA.

8. Dependent Claim 8

It would have been obvious for "*the conversion of the luminance, red chroma difference, and blue chroma difference values to blue, green, and cyan signal values* ***incorporates a subtraction of approximately 1.5 times the red chroma difference value from the luminance value***" as required by claim 8. It would have been a routine matter of experimentation with matrix coefficients for a POSITA to incorporate a subtraction of approximately 1.5 times the red chroma difference value from the luminance value. This would require the POSITA to merely select the appropriate matrix coefficients when calculating the blue, green, and cyan outputs based on CMYG signals, according to conventional techniques in the art. (Ex. 1001 at 4:66-6:59; Gunday at ¶167-69.) Such mathematical experimentation with matrices was known and common in the art to obtain the appropriate endoscopic images. (Gunday at ¶¶ 53-56.) A POSITA would be motivated to try using the claimed subtraction to ensure the elimination the red input component (Rii) from the calculations of the RGB output signals in Yabe's "G+B", "G" or "B" modes, as a POSITA would know that eliminating that red component by incorporating the above subtraction is likely to improve the diagnostic functions of the resulting endoscopic images in the G+B, B, and G modes of Yabe's second embodiment. (Ex. 1007 at 12:62-66, 13:11-16, Table 1.2; Gunday at ¶169-70.) Claim 8 is therefore obvious in view of Yabe and the knowledge of a POSITA.

9. Dependent Claim 9

It also would have been obvious for "*the conversion of the luminance, red chroma difference, and blue chroma difference values to blue, green, and cyan signal values* <u>*incorporates a contribution from the blue chroma difference value to the green, cyan and blue signals in a ratio of approximately 1:4:6, respectively*</u>" as required by claim 9. First, a POSITA would appreciate that, as with the "*subtraction of approximately 1.5 times*" in claim 8, choosing the *ratio of approximately 1:4:6* is simply a matter of selecting the appropriate matrix coefficients for calculating the blue, green, and cyan signal values. (Ex. 1001 at 4:66-6:59; Gunday at ¶171-72.) A POSITA would have been motivated to select matrix coefficients corresponding to the claimed 1:4:6 ratio to generate an improved endoscopic image display in the "G+B" mode of Yabe's second embodiment, such that the colors in the displayed image included the desired amount of green, blue, and cyan color contributions. (Ex. 1007 at 12:62-66 (G+B mode is "effective for endoscopic examinations using different shades of blue."); Gunday at ¶172-73.) Motivation is also provided by Yabe's, which explains that the color adjustment/matrix/calculations circuit uses RGB output equations having different coefficients applied to the three color inputs from the CCD. (Ex. 1007 6:65-7:5, 8:36-12:61, Table 1.2.) In sum, claim 9 is obvious in view of Yabe and the knowledge of a POSITA.

10. Independent Claim 10

First, Yabe discloses "*[a]n imaging system for generating white light images and short wavelength visible images of tissue in response to a broad band illumination light that is delivered to a tissue sample and providing those images to one or more color video monitors*" as recited by claim 10. Yabe's second embodiment includes an endoscopic apparatus that, when in the "Normal mode," enables the generation of "normal" images from the full spectrum of visible light (i.e. using white light or all the Rii, Gii, and Bii components of illuminating light that is reflected off a subject under endoscopic examination), and a POSITA would understand such "normal" images to be white light images. (*See, e.g.*, Ex. 1007 at 1:11-16, 1:65-2:29, 2:5-8, 5:64-6:6:59, 13:16-14:64, Table 1.2 ("Normal mode"); Gunday at ¶174-75, 192.) Yabe's endoscopic apparatus also generates short wavelength images, such as images consisting of blue and/or green wavelength light components, when in various modes such as the "G+B", "B" or "G" modes, "thereby making it possible to display the inherent pieces of information obtained by different wavelengths in such a manner that they can be easily distinguished from each other." (Ex. 1007 at 2:9-15, 2:22-29; Gunday at ¶176, 193.)

Yabe discloses that the images of tissue are *in response to a broad band illumination light that is delivered to a tissue sample*. The broadband illumination light comes from a "light source section 23 [that] serves to form a parallel beam out of the light from an illuminating lamp 34" and that light is passed through a rotary filter to provide sequential illuminating lights of red, green, and blue wavelengths to a subject under endoscopic examination. (Ex. 1007 at 5:25-29, 5:40-53, 5:54-63, Fig. 2.) A POSITA would consider that the sequential red, green, and blue light to be broadband illumination because red, green, and blue wavelengths cover the full visible spectrum of light. (Gunday at ¶¶177-81, 32; Ex. 1007 at 6:27-43, 1:21-26, 6:53-59.)

To the extent that directing sequential red, green, and blue light to the subject is not equivalent to directing broadband illumination light to the subject, it would have been obvious to direct broadband light in the form of white light to the subject, according to the Yabe's teachings and the knowledge of a POSITA. Yabe's first embodiment teaches the illumination of a subject with direct white light from a lamp, which is then reflected onto the surface of a CCD having an attached RGB mosaic filter (i.e. to an RGB color image sensor). (Ex. 1007 at 3:12-34, Figure 1; Gunday at ¶182-83.) It would have been obvious to use the RGB color image sensor from Yabe's first embodiment as the color image sensor in Yabe's second embodiment as this would involve a routine substitution of known, interchangeable components to obtain the same predictable result (i.e. that red, blue and green light is directed onto the pixels of the endoscope's CCD). (Gunday at ¶183.) A POSITA would be motivated to make this change because Yabe's second embodiment indicates that it can be used with endoscopes with "color filters attached to the CCD" and also states that the second embodiment can be applied "to a system composed of an electronic scope with a built-in color filter used under a white light illumination." (Ex. 1007 at 6:44-49, 18:17-21; Gunday at

¶183.)

Next, Yabe's second embodiment discloses that in response to receiving the light that light is reflected from the subjected, the CCD forms an optical image of the subject and stores it as a signal charge. (Ex. 1007 at 5:64-6:5; Gunday at ¶181.) Also, Yabe discloses "*providing those images to one or more color video monitors*" as recited by claim 1, including monitors 25 and 26 as shown in Fig. 2. (Ex. 1007 at 5:24-34, Fig. 2; Gunday at ¶184.)

Second, Yabe also discloses "*an image sensor that receives reflected light from the tissue sample, the image sensor having a number of pixels sensitive to different wavelengths of light and which generate image signals in response to the light received from the tissue sample*" as recited by claim 10. Yabe's CCD 42 is an image sensor that receive reflected red, green, and blue light and a POSITA would understand that the CCD's pixels (image pickup surface) are inherently sensitive to different wavelengths of light. (Ex. 1007 at 5:64-68, Fig. 2; Gunday at ¶¶185-86, 43-47.) The CCD's pixels generates image signals in response to the received light by effecting "photoelectric conversion of an optical image." (Ex. 1007 at 6:1-4; Gunday at ¶186-87.)

Third, Yabe discloses "*an image processor that receives a set of image signals from the image sensor and produces a white light image of the tissue sample from the set of image signals and a short wavelength image of the tissue sample from a subset of the image signals*" as required by claim 10. The "white light images" are the "normal" images that are generated in Yabe's second embodiment in the "Normal mode," and the short wavelength images are the specific wavelength images (e.g. images generated from Bii and Gii light components) that are generated in the G+B, B, or G modes of Yabe's second embodiment. (*See* Ex. 1007 at Table 1.2 ("G+B mode", "B mode", "G mode" and "Normal mode"), Fig. 2, 6:1-4 ("video processor 24"), 6:5-11, 6:65-7:1,10:39-14:64, 10:55-59, 11: 52-56, 13:57-59, 14:5-7; Gunday at ¶¶188-94, 122.)

Fourth, Yabe discloses "*wherein the short wavelength image of the tissue is produced by substantially eliminating a contribution of red light in the set of image signals*" as required by claim 10. As discussed above and in the analysis of the last element of claim 1, in the G+B mode, Yabe's second embodiment produces images comprising green and blue components, which a POSITA would understand to be short wavelength images, because it is well known that green and blue wavelengths are in the short wavelength portion of the spectrum. (Ex. 1007 at 1:54 ("the blue component has a short wavelength"), Table 1.2; Gunday at ¶¶195-96, 122-26.) Therefore claim 10 is obvious in view of Yabe and the knowledge of a POSITA. (Gunday at ¶ 197.)

11. Dependent Claim 11

It would have been obvious for "*the image sensor [to be] located at the distal end of an endoscope*" as required by claim 11. This would involve a simple design choice that would be obvious to try because it would yield predicable results without changing the function of the image sensor Yabe's endoscopic apparatus (i.e. image capture). (Gunday at ¶198-99.) A POSITA would also be encouraged to locate the image sensor at the endoscope's distal end because Yabe's third embodiment teaches that the image sensor is located at the distal tip of the endoscope. (Ex. 1007 at Fig. 10 (color filter 201 and CCD 202); Gunday at ¶199-200.) A POSITA would be motivated to make that design choice to permit more reflected light from the tissue surface to be captured by the CCD's surface. (*Id.*) Claim 11 is therefore rendered obvious by Yabe and the knowledge of a POSITA.

12. Dependent claim 12

It would have been obvious for "*the image sensor [to be] located at the proximal end of an endoscope*" as required by claim 12. This would involve a simple design choice that would be obvious to try because it is widely used in the art and would yield predicable results without changing the function of the image sensor Yabe's endoscopic apparatus (i.e. image capture). (Gunday at ¶201-02.) A POSITA would also be encouraged to locate the image sensor at the endoscope's proximal end because Yabe's first embodiment teaches that the color image sensor is located at the proximal tip of the endoscope. (Ex. 1007 at Fig. 1 (items 17 and 17a); Gunday at ¶202-03.) Claim 12 is therefore rendered obvious by Yabe and the knowledge of a POSITA.

13. Dependent Claim 13

It would have been obvious for "*the image sensor [to be] an RGB sensor*" as required by claim 13. As discussed above in the analysis for claims 1 and 2, Yabe's second embodiment includes an RGB sensor comprising a rotary filter having red, green, and blue transmission filters, and a CCD 42. (Ex. 1007 at Fig. 2; Gunday at ¶¶204-05, 113-15.) As also discussed above, to the extent that this rotary filter/CCD 42 arrangement is not an RGB sensor, it would have been obvious to replace that arrangement with a CCD having a RGB mosaic filter attached to it, as taught by the first embodiment of Yabe, and as suggested by Yabe's second embodiment as an alternative configuration. (Ex. 1001 at 3:25-33, Fig. 1, 6:44-49, 18:17-23; Gunday at ¶¶206-07, 116-17, 183.) For the same reasons, it would have been obvious to use such an RGB image sensor in Yabe's second embodiment. Claim 13 is therefore obvious over Yabe in view of the knowledge of a POSITA.

14. Dependent Claim 14

It would have been obvious for "*the image sensor [to be] a CMYG sensor*" as required by claim 14. This would involve a simple design choice that would have been obvious to try because it involve simply replacing the conventional rotary filter/CCD arrangement in Yabe's second embodiment with a known CMYG image sensor having a CMYG mosaic filter to obtain predictable results (i.e. the generation RGB signal components via the conventional matrix calculations using luminance, red and blue chroma differences, and CYMG signal components). (Gunday at ¶¶208-210, 157-65, 43-46.) A POSITA would have been motivated to make this design change because Yabe suggests the use of CCDs having built-in color filters, and Yabe's third embodiment discloses a CMYG-type CCD with a built-in color filter. (Ex. 1007 at 6:44-49, 18:17-24, 19:1-43, Fig. 10 (CCD 202 with built-in color filter 201), Fig. 11, Fig. 12A.) Therefore, claim 14 is obvious over Yabe in view of the knowledge of a POSITA.

15. Dependent Claim 15

It would have been obvious for "*the image processor has sufficient processing speed and a display memory to process and provide for both a white light image and a short wavelength image within a video frame*" as required by claim 15. It would have been obvious to use such a processor in Yabe's second embodiment for several reasons. First, Yabe allows users of the endoscopic apparatus to "alternately output and compare[]" normal and short wavelength image and allows images to be output to two monitors. (Ex. 1007 at 14:57-64, Fig. 2.) Second Yabe's third embodiment teaches that "a normal color image and a specific wavelength region image are simultaneously displayed, side by side" on the same monitor, and so "the physician is enabled to perform a sophisticated diagnosis by comparing the two images with each other." (Ex. 1007 at Fig. 14, 20:55-64.) A POSITA would therefore be motivated to use the two monitors in the second embodiment to view normal (white light) or specific wavelength region images (i.e. short wavelength images) side by side on the same or on both monitors in the second embodiment to better compare the images during endoscopic examinations. (Gunday at ¶¶211-16, 148, 184.) A POSITA would also appreciate that to obtain such display capability, Yabe's video processor 24 would need to have sufficient power and display memory. It would be a matter of routine experimentation to find the right processor and display memory, as they were well known in the art, including the "6400 series of processors from Texas Instruments Corp." disclosed in the 151 patent. (Ex. 1001 at 8:23-24; Gunday at ¶¶211-16.) Claim 15 is therefore obvious over Yabe in view of the knowledge of a POSITA.

16. Dependent Claim 16

It would have been obvious for "*the white light image and the short wavelength image [to be] simultaneously displayed on the same color video monitor*" as recited by claim 16. As discussed above, Yabe's third embodiment discloses that a "normal color image and a specific wavelength region image are simultaneously displayed, side by side." (Ex. 1007 at 20:55-59, Fig. 14 (displaying a "normal" (i.e. white light) image and a shortwave length green image (G_2) on the same monitor).) A POSITA would have found it obvious to use one of the monitors in Yabe's second embodiment for such a side by side display "to perform a sophisticated diagnosis by comparing the two images with each other." (*Id.* at 20:60-64, 14:60-64; Gunday at ¶¶217-19.) Claim 16 is therefore obvious in view of Yabe and the knowledge of a POSITA.

17. Dependent Claim 17

It would have been obvious for "*the white light image and the short wavelength image are simultaneously displayed on two separate video monitors*" as recited by claim 17. As discussed above, Yabe's second embodiment discloses the use of two separate monitors for image display. (Ex. 1007 at Fig 2 (monitors 25 and 26).) Yabe's first embodiment also teaches that a "first monitor" is used to display "an endoscope image of a wavelength region (generally equal to the entire visible region)" (i.e. a white light image), and "second, third, and fourth monitors 8, 9, and 10 are respectively monochrome-displayed the red, green, and blue components of an endoscopic image." (*Id.* at 4:25-40, Fig. 1.) A POSITA would have found it obvious to combine the teachings of Yabe's first, second and third embodiments to view white and short wavelength (e.g. green and blue) endoscopic images side by side on two separate monitors, because it would involve using known techniques and monitor configurations to direct image signals to separate monitors (as shown in Yabe's Figure 2 and Figure 1), and it would also allow for a sophisticated diagnosis by comparing the two images with each other. (Gunday at ¶¶220-25.) Claim 17 is therefore obvious over Yabe in view of the knowledge of a POSITA.

B. Ground 2: Claims 1, 10, 11 and 13 Are Anticipated By Cooper

1. Claim 1

First Cooper discloses *"[a] system for producing images of tissue with a medical device that delivers an illumination light to a body cavity and a color image sensor that produces images of the tissue from a number of pixels that are sensitive to different wavelengths of light*" as recited by claim 1. Cooper's "*system for producing images of tissue*" is "a color video endoscope system . . . having electronic filter coloring to alter the true color of the image presented on the monitor." (Ex. 1003 at 1:6-9.) The endoscope system is a medical device and it includes a xenon short-arc light source that transmits illumination light that is " direct[ed] into the cavity." (*Id.* at 4:1-2, 4:13-18, 4:39-43, 7:50-68; Gunday at

¶¶227-29.) Cooper's endoscope system also includes a claimed color image sensor which comprises a "color wheel 40" arrangement with "a solid state image sensor for transmitting a signal in response to the intensity of the reflected fields of [red, green, and blue] light." (Ex. 1003 at 4:39-43, Abstract, 4:1-6, Fig. 2 (item 72); Gunday Dec. at ¶229.) The solid state image sensor has "active light-responsive elements" (i.e. pixels) "for receiving the reflected image from the cavity and generating sequential electrical signals corresponding to the sequential color fields of light." (Ex. 1003 at 2:3-11, 4:39-5:44; *see also id.* at 6:2-6, 6:22-7:40; Gunday at ¶¶230-31.) A POSITA would understand that red, green, and blue light have different wavelengths. (Gunday at ¶¶31-32.)

Second, Cooper discloses "*an image processor coupled to receive signals produced by the color image sensor in response to illumination light reflected from the tissue having red, green, and blue color components*" as recited by claim 1. For example, Cooper's image processor is a "video processor" that "receives the output signal from the image sensor" and "convert[s] the signal from the image sensor into a composite RGB signal compatible with a color monitor." (Ex. 1003 at Abstract, 2:3-18, 3:42-47, 3:55-56, 4:10-66, Fig. 2 (item 48); Gunday at ¶232.)

Third, Cooper discloses "*wherein, the image processor calculates image signals that are stored in a memory by minimizing the contribution from signals produced by the image sensor in response to red illumination light*" as recited by claim 1. Cooper's video processor calculates image signals by processing them into an RBG signal for display, and also uses potentiometers and electronic color filters to "alter" the color of the images on the monitor. (Ex. 1003 at 1:67 – 2:2, 2:11-14, 2:19-33, at 3:9-12, Fig. 3, 5:18-7:40, 6:2-21, Abstract, Fig. 3; Gunday at ¶¶233-39.) Cooper's video processor minimizes that contribution of red illumination light by designing the settings for the potentiometers to set the gain for the red signal to zero, such that "no red . . . signal will be output by the video processor 48." (Ex. 1003 at 6:59-66, 7:8-21.) The video processor's output signals are stored in "memory storage units." (*Id.* at 3:60-62, 4:60-5:10, Fig. 2.)

2. Claim 10

First, Cooper discloses *"[a]n imaging system for generating white light images and short wavelength visible images of tissue in response to a broad band illumination light that is delivered to a tissue sample and providing those images to one or more color video monitors*" as recited by claim 10. This is the same system discloses above with respect to claim 1. The "white light images" are the "true color" images that Cooper's system generates "if no color filtering is desired so that the image on the monitor is to be the true color[.]" (Ex.. 1003 at 2:52-61, 5:18-44, 5:56-58, 5:64-6:2, 6:22-34.) The "short wavelength visible images" are generated by Cooper's electronic color filter combination to alter the true color of the displayed image to, for example, a blue image by removing or reducing red light components. (*Id.* at 1:6-10, 1:65-2:2, 2:19-47, 6:10-21, 6:49-7:22, 7:22-40; Gunday at ¶¶240-43.) The images are generated in response to broadband illumination light sourced at a xenon short-arc lamp and passed through a color wheel for "generating and delivering sequential fields of red, green, and blue light into the cavity." (Ex. 1003 at 2:3-6, 4:13-15.) One of ordinary skill in the art would appreciate that a xenon short-arc lamp is a broadband light source, and that the sequential fields of red, blue and green span the full spectrum of visible light and therefore comprise broadband illumination light. (Gunday at ¶¶242, 30, 34, Ex. 1001 at 8:47-58.) Cooper also discloses that the generated images are ultimately displayed on a monitor. (Ex. 1003 at 2:8-10, 2:11-14.)

Second, Cooper discloses "*an image sensor that receives reflected light from the tissue sample, the image sensor having a number of pixels sensitive to different wavelengths of light and which generate image signals in response to the light received from the tissue sample*" as recited by claim 10. As discussed above in the claim 1 analysis, Cooper's "solid state image sensor" has "active light-responsive elements" (i.e. pixels) that are sensitive to red, blue, and green wavelengths of light, and those pixels are "for receiving the reflected image from the cavity and generating sequential electrical signals corresponding to the sequential color fields of light." (Ex. 1003 at Abstract, 2:3-14, 4:1-6; Gunday at ¶¶244-45, 227-32.)

Third, Cooper discloses "*an image processor that receives a set of image signals from the image sensor and produces a white light image of the tissue sample from the set of image signals and a short wavelength image of the tissue sample from a subset of the image signals*" as recited by claim 10. As discussed above, Cooper's video processor produces "true color" (white light) images when no filter is desired, and "short wavelength" images from a subset of the signals received from the solid state image sensor when it is desired to change the color of the displayed image from its true color to another color. (Gunday at ¶¶246-47, 240, 233-37.)

Fourth, Cooper discloses "*wherein the short wavelength image of the tissue is produced by substantially eliminating a contribution of red light in the set of image signals*" as recited by claim 10. As discussed above in connection with claim 1, Cooper discloses that a blue image (i.e. a short wavelength image) is produced by removing red and green light component signals that are received from the image sensor. (Ex. 1003 at Abstract, 1:67-2:2, 5:45-6:10, 6:49-67; Gunday at ¶¶248, 237.) Cooper therefore anticipates claim 10.

3. Dependent Claim 11

Cooper discloses "[t]he system of claim 10, wherein the image sensor is located at the distal end of an endoscope" as recited by claim 11. Cooper's video endoscope has a viewing head located its distal end, and the image sensor is in the viewing head. (Ex. 1003 at 3:20-22, 3:30-33, Fig. 1.) Therefore, Cooper's image sensor is at the distal end of the video endoscope. Cooper therefore anticipates claim 11. (Gunday at ¶¶249-50.)

4. Dependent Claim 13

Cooper discloses "[t]he system of claim 10, wherein the image sensor is an RGB sensor" as recited by claim 13. Cooper's solid state sensor has light-responsive elements that receive red, green and blue light that passed through a color wheel and reflected off a body cavity onto the sensor, therefore Cooper discloses the an RGB sensor. (Ex. 1003 at Abstract, 2:3-11, 3:42-45, 4:10-66, 5:26-29, 5:39-44.) Cooper therefore anticipates claim 13. (Gunday at ¶¶251-52.)

C. Ground 3: Claims 1, 7, 10, 12 and 14 Are Anticipated By Krauter

1. Independent Claim 1

First, Krauter discloses "*[a] system for producing images of tissue with a medical device that delivers an illumination light to a body cavity and a color image sensor that produces images of the tissue from a number of pixels that are sensitive to different wavelengths of light*" as required by claim 1. This system includes a "video colposcope [that] includes a system microcomputer having algorithms for color balance levels stored into memory," and a "video camera that obtains a subject electronic image of a subject object" and "[produces] a modified electronic image corresponding to the subject electronic image." (Ex. 1004 at Abstract.) The colposcope is a medical device that is used "to enhance vascular discrimination" and "for . . . cervical examination" which necessarily involve taking images of tissue in body cavities. (*Id.* at 1:11-14; 1:6-8; Gunday at ¶¶254-55.) Krauter discloses that an "illuminating light beam" is delivered to a "target" (i.e. tissue in the body cavity.) (*Id.* at 5:60-64.) Krauter discloses the claimed color image sensor as a "CCD image sensor 13" which is a "complementary color CCD" (i.e. a CMYG image sensor). (Ex. 1004 at 4:7-12; Fig. 1 (item 13), Fig. 7; Gunday at ¶¶256-7.) The CCD converts a reflected image of the tissue into an electrical signal that includes various "chrominance (color) components," which means that the CCD has pixels sensitive to different color wavelengths of light. (Ex. 1004 at 4:12-17, 6:19-28, 5:53-55, Fig. 1; Gunday at ¶¶257.)

Second, Krauter discloses "*an image processor coupled to receive signals produced by the color image sensor in response to illumination light reflected from the tissue having red, green, and blue color components*" as recited by claim 1. Krauter's DSP receives the electrical signals from the CCD (which the CCD created in response to receiving reflected illuminating light from the target) and then "separates the image data into luminance (black and white) and chrominance (color) signals." (Ex. 1004 at 4:7-13, 6:19-28, 5:53-55, Fig. 1.) "The chrominance signal passes to the [DSP's] chrominance processor 23, which provides the proper ratio and amplitude of the three color primaries (red, green, blue)." (Ex. 1004 at 4:22-25; Fig. 1 (items 18, 23); Gunday at ¶¶258-59.)

Third, Krauter discloses "*wherein, the image processor calculates image signals that are stored in a memory by minimizing the contribution from signals produced by the image sensor in response to red illumination light*" as recited by claim 1. Krauter's colposcope has two modes of operation: "normal" and "green filter," where "green filter" refers to "images obtained primarily by reducing the amount of red found in the actual image so as to offset the problems of vascular discrimination." (Ex. 1009 at 4; Ex. 1004 at 4:7-10.) In the "green filter" mode, Krauter's DSP calculates image signals where the red portion of light is decreased or suppressed. (Ex. 1004 at Abstract, 1:11-19, 4:66-67, 2:61-67, 2:67-3:6, 4:66 – 5:5, 5:5-14, 5:15-52, Fig. 1; Gunday at ¶¶260-63, 265.) The image signals that are calculated by the DSP Are stored in memory "buffers" for display on a monitor. (Ex. 1004 at 4:49-52; Gunday at ¶264.) Krauter therefore anticipates claim 1.

2. Dependent Claim 7

Krauter discloses "*[t]he system of claim 1, wherein the image sensor is a CMYG sensor having pixels that are primarily sensitive to cyan, magenta, yellow, and green light, wherein the image processor computes luminance, red chroma difference and blue chroma difference values from CMYG pixel signals and converts the luminance, red chroma difference and blue chroma difference into blue, green, and cyan signal values and stores these signal values in the memory*" as recited by claim 7. As discussed above, Krauter's CCD is a CYMG image sensor. (Ex. 1004 at Fig. 7, 3:52-58, 5:15-44.) The '151 patent admits that it was known in the art that signals generated by CYMG image sensors were used to calculate luminance, red chroma values, and blue chroma values and convert them into red, green, and blue signals, and even provides examples of such calculations. (Ex. 1001 at 5:63-6:37.) Consistent with this, Krauter discloses that Krauter's DSP conducts luminance processing and chrominance processing to obtain "the proper ratio and amplitude of the three color primaries (red, green, blue)" which are "processed as vector quantities, with . . . the angle of the vector representing hue (i.e. <u>pure green</u>, greenish red, <u>greenish blue [i.e. cyan]</u>, etc.)." (Ex. 1004 at 4:16-29.) Further, Krauter's processor modifies the vectors to enhance the green response and suppress the red response, and to "adjust the green and blue vectors in the absence of red." (*Id.* at 5:5-44.) A POSITA would understand these disclosures to mean that the DSP calculates blue, green, and cyan signals, which would then be stored in the memory "buffers." (*Id.*; Gunday at ¶¶266-72.) Krauter therefore anticipates claim 7.

3. Independent Claim 10

First, Krauter discloses "*an imaging system for generating white light images and short wavelength visible images of tissue in response to a broad band illumination light that is delivered to a tissue sample and providing those images to one or more color video monitors*." This is the same imaging system that was analyzed above with respect to claim 1. Further, the "white light images" are the images that are created when the colposcope is in the "normal" mode, and the short wavelength images are those that are created when the colposcope is in its "green filter" mode (i.e. when the red portion of a video signal is decreased). (Ex. 1004 at 1:55-2:47, 2:61-67, 3:43-4:6, 3:43-51, 4:2-6, 4:9-38, 4:23-31, 4:31-33, 5:45-52, Fig. 1, Fig. 9; Gunday at ¶¶273-74.) These images are generated in response to broadband illumination light from Krauter's "low power halide and discharge lamp assembly including a low power arc lamp." (Ex. 1004 at 5:60-63, 5:64-67; Ex. 1001 at 8:47-58 (halide and arc lamp technologies were known broadband light sources); Gunday at ¶¶275-76.). The images generated by Krauter's colposcope are displayed on an RGB video monitor. (Ex. 1004 at Fig. 9, 3:43-67, 4:31-33, 4:49-52, Fig. 1.)

Second, Krauter discloses "*an image sensor that receives reflected light from the tissue sample, the image sensor having a number of pixels sensitive to different wavelengths of light and which generate image signals in response to the light received from the tissue sample*." This element of claim 10 is disclosed by Krauter as set forth in the above discussion of the CCD imager sensor 13 in the analysis for the preamble of claim 1 and first element of claim 1. (*See supra* section VII.C.1; Gunday at ¶¶277-78, 254-59; *see also* Ex. 1004 at 4:11-17, 6:19-28.)

Third, Krauter discloses "*an image processor that receives a set of image signals from the image sensor and produces a white light image of the tissue sample from the set of image signals and a short wavelength image of the tissue sample from a subset of the image signals*." As discussed above, Krauter's DSP creates "normal" (i.e. true color, white light) images from the set of signals received from the CCD imager sensor in the "normal" mode, and the shortwave length images are created from green and blue image signals in the "green filter" mode. (*See also* Gunday at ¶¶279, 273-76.)

Fourth, Krauter discloses "*wherein the short wavelength image of the tissue is produced by substantially eliminating a contribution of red light in the set of image signals*." For example, in the "green filter" mode, the red response is suppressed, while the green response is enhanced. (Ex. 1004 at 2:61-3:11, 4:7-17, 4:66-5:44; Gunday at ¶¶280, 258-59.) Krauter therefore anticipates claim 10.

4. Dependent Claim 12

Krauter discloses *"[t]he system of claim 10, wherein the image sensor is located at the proximal end of an endoscope*." Krauter discloses that the CCD imager sensor's surface is the "optically active surface" of the SONY camera depicted in Figure 1 and 3, and in Figure 3, the SONY camera (i.e. represented conventional imaging camera 46) is located in the housing 42 of the colposcope

40, which means the imager sensor is also located there. Referring to Figures 2 and 3, the camera 46 is located at the proximal (i.e. viewing) end of the colposcope, which confirms that the imager sensor 13 is also located at the proximal end. (Ex. 1004 at 4:10-12, 5:53-60, 6:19-32, Fig. 1, Fig. 2, Fig. 3; Gunday at ¶¶281-83.) Krauter therefore anticipates claim 12.

5. Dependent Claim 14

Krauter discloses *"[t]he system of claim 10, wherein the image sensor is a CMYG sensor*." As discussed above, Krauter's "CCD imager sensor 13" is a "complementary CCD", which is a CMYG image sensor. (Gunday at ¶¶284-85, 257.) Krauter therefore anticipates claim 14.

D. Ground 4: Claims 1, 2, 10 and 13 Are Anticipated By The "FICE 2005 Brochure"

Petitioner's anticipation analysis relies on the FICE 2005 brochure (Ex. 1005) as the primary reference. As set forth below and in the Declaration of Erhan Gunday, to the extent that any element is not explicitly disclosed by Ex. 1005, that element is inherently disclosed by Ex. 1005 in view of the disclosures in FICE-related Exhibits 1008, 1010, 1013, 1014, and 1015, which Petitioner is relying on solely for the purpose of proving inherency.

1. Independent Claim 1

First, the FICE 2005 brochure discloses *"[a] system for producing images of tissue with a medical device that delivers an illumination light to a body cavity and a color image sensor that produces images of the tissue from a number of* *pixels that are sensitive to different wavelengths of light*." The FICE 2005 brochure discloses Fuji Intelligent Chromo Endoscopy (FICE) imaging (also known as Fuji's Flexible spectral Imaging Color Enhancement) which is installed on Fuji's EPX-4400 (which includes the video processor VP-4400 and the Light Source XL-4400). (Ex. 1005 at 1-5, Ex. 1013 at 7-10, 22.) FICE "takes an ordinary endoscopic image from the video processor and arithmetically processes, estimates and produces an image of a given, dedicated wavelength of light." (Ex. 1005 at 2-4 (also showing FICE images of tissue); Ex. 1013 at 7-8; Gunday at ¶¶286-87.) The FICE 2005 brochure inherently discloses that it delivers illumination light from a short arc Xenon lamp to a body cavity in order to generate the FICE images in the FICE 2005 brochure. (Ex. 1005 at 2-4 (images are "captured by the Fujinon electronic scope"); Ex. 1014 at Fig. 8 (Xenon lamp directing "white light" to a "tissue surface"); Ex. 1013 at 22 (XL-4400 is a "short-arc Xenon lamp"); Gunday at ¶¶289.)

The FICE 2005 brochure also inherently discloses the claimed color image sensor. (Ex. 1005 at 4 ("F.I.C.E. Image Processing Flowchart" and discloses that "[a]n image captured by the Fujinon electronic scope is sent to the Spectral Estimation Matrix processing circuit in the EPX-4400… where "various pixilated spectrums of the image are estimated," making it possible to implement imaging on a single wavelength."), 5 (discussing the Super CCD technology); Ex. 1013 at Figure 8 (showing a "color CCD" which is a color image sensor) and Fig. 10; Ex. 1013 at 9-10 (showing the Super CCD chip having a "RGB filter"); Gunday at

¶¶290-92.)

Second, the FICE 2005 brochure discloses "*an image processor coupled to receive signals produced by the color image sensor in response to illumination light reflected from the tissue having red, green, and blue color components*." The FICE image processor is the VP-4400 processor that is in the EPX-4400. (Ex. 1005 at 2, 4 (discussing the EPX-4400 processing functionality); Ex. 1013 at 7, 22; Gunday at ¶293.) FICE inherently discloses that the processor receives signals from the color image sensor in response to illumination light reflected from the tissue having red, green, and blue color components. (*See, e.g.* Ex. 1014 at Fig. 8, Fig. 10 (references to R, G, B); Gunday at ¶¶294-95.)

Third, the FICE 2005 brochure discloses "*wherein, the image processor calculates image signals that are stored in a memory by minimizing the contribution from signals produced by the image sensor in response to red illumination light.*" Exhibit 1005 inherently discloses this element. For example, the brochure mentions that "single wavelengths are randomly selected, and assigned to R (red), G (Green), and B (Blue) respectively to build and display a F.I.C.E. enhanced color image." (Ex. 1005 at 4.) Further, the FICE 2005 brochure discloses images having "shorter wavelengths around 400-500 nm" (i.e. violet, blue, and green wavelengths) and states that "FICE makes it possible to select the <u>most suitable wavelengths</u>." (Ex. 1005 at 4.) The FICE 2005 brochure also disclose actual images and flowcharts/diagrams where the red light contribution was minimized or eliminated. (Ex. 1005 at 2-4 (images having wavelengths in the blue and green parts of the spectrum); Ex. 1015 at Fig. 262, 5(b), Ex. 1014 at 12, Fig. 11(b); Ex. 1008 at 2 (showing only blue and green wavelengths in the "Display on the monitor" after "FICE processing (image processing)); Gunday at ¶¶296-302.)

2. Dependent Claim 2

FICE discloses *"[t]he system of claim 1, wherein the image sensor is an RGB sensor having pixels that are primarily sensitive to red, green, and blue light, and wherein the image processor receives signals from each of the sensor pixels and computes the image signals for storage in the memory from the signals produced by the pixels that are sensitive to green and blue light only*." The FICE 2005 brochure inherently discloses the claimed RGB image sensor. (Ex. 1005 at Flowchart (showing Original R, G, B images generated from the Original Image), Ex. 1014 at Fig. 8 (B, G and R light signals produced by the "color CCD" image sensor after it receives reflected white light from the image), Fig. 9 (various FICE images "[e]stimated from an RGB image"); Ex. 1015 at 262 ("[t]he RGB signals from the CCD" are digitized and "the [FICE] image is estimated . . . from corrected RGB signals."); Gunday at ¶¶303-09.) As discussed above, the FICE system computes some image signals from green and blue light only. (Ex. 1005 at 3, Ex. 1008 at 2 ("Display on the monitor" using only blue and green); Gunday at ¶¶310-13.)

3. Independent Claim 10

First, the FICE 2005 brochure discloses *"[a]n imaging system for* *generating white light images and short wavelength visible images of tissue in response to a broad band illumination light that is delivered to a tissue sample and providing those images to one or more color video monitors*." This is the same system analyzed above in the discussion of claim 1. The "ordinary" or "conventional" images generated by the FICE system are "white light images." (Ex. 1005 at 2 (Case 1 left image), 3-4; Ex. 1014 at Fig. 8 ("Conventional image"); Gunday at ¶314-16.) The FICE images include images of "shorter wavelengths around 400-500 nm," which are the claimed short wavelength images. (Ex. 1005 at 4; Gunday at ¶¶315-16.) The FICE brochure inherently discloses the claimed broadband illumination light, which is a Xenon lamp. (Ex. 1005 at 2-4; Ex. 1014 at Fig. 8 ("Xenon lamp"); Ex. 1013 at 22 (XL-4400 "Main lamp" is a "short-arc Xenon lamp); Gunday at ¶317.) Both the ordinary and FICE images are displayed on monitors. (Ex. 1005 at 2, 4 (discussing the assignment of RGB images and the display of FICE enhanced color images); Ex. 1008 at 3 (FICE on demand switching); Gunday at ¶318.)

Second, the FICE 2005 brochure discloses "*an image sensor that receives reflected light from the tissue sample, the image sensor having a number of pixels sensitive to different wavelengths of light and which generate image signals in response to the light received from the tissue sample.*" This is the same color CCD image sensor (which is an RGB sensor) discussed above in the analysis of the preamble and first element of claim 1. (*See also* Ex. 1005 at 5 (referencing "Super CCD"); Ex. 1014 at Fig. 8 ("color CCD"); Ex. 1013 at 10 (showing Super CCD chip with RGB filter and "unique pixel layout"); Gunday at ¶¶319-20, 290-92.)

Third, the FICE 2005 brochure discloses "*an image processor that receives a set of image signals from the image sensor and produces a white light image of the tissue sample from the set of image signals and a short wavelength image of the tissue sample from a subset of the image signals*." As discussed above, the FICE 2005 brochure discloses the generation of "Original RGB" (i.e. white light) images from light reflected off the "tissue surface" and FICE images (e.g. short wavelength images in the 400-500 nm range or images using only green and blue wavelengths). (Ex. 1005 at 2-4; Ex. 1014 at 10-12; Ex. 1008 at 3; Gunday at ¶¶321-22, 293-94)

Fourth, the FICE 2005 brochure discloses "*wherein the short wavelength image of the tissue is produced by substantially eliminating a contribution of red light in the set of image signals*." As discussed above, FICE discloses the short wavelength images generated from only blue and green wavelengths, indicating that the red contribution was substantially eliminated. (Ex. 1005 at 2 (Case 1), Ex. 1008 at 2; Gunday at ¶¶323, 296-301.) The FICE 2005 brochure therefore anticipates Claim 10.

4. Dependent Claim 13

The FICE 2005 brochure discloses "the system of claim 10, wherein the image sensor is an RGB sensor." The FICE 2005 brochure inherently discloses that the FICE color image sensor is an RGB image sensor. (Ex. 1005 at 4 ("Original R, G, B image"); Ex. 1014 at Figure 8 (color CCD generating R, G, B signals); Ex. 1013 at 10 ("Super CCD chip" has an "RGB filter"); Gunday at ¶¶324-26.) The FICE 2005 brochure therefore anticipates claim 13.

E. Ground 5: Claims 1, 10, 11, 13 and 15-17 Are Anticipated By Ozawa.

1. Independent Claim 1

First, Ozawa discloses "*[a] system for producing images of tissue with a medical device that delivers an illumination light to a body cavity and a color image sensor that produces images of the tissue from a number of pixels that are sensitive to different wavelengths of light*." Ozawa discloses "a system for producing images of tissue" including "an electronic *endoscope system* in which an *endoscope image* is reproduced as a *full color image* on a TV monitor." (Ex. 1006 at 1:6-9, 8:38-53.) Ozawa's system delivers an illumination light onto a patient's organ with a "white light lamp" such as a "xenon lamp," which is a broadband illumination light. (Ex. 1006 at 8:54-56; 18:50-55; Gunday at ¶¶327-28.) Reflected light from the illuminated object is focused on Ozawa's color image sensor, which is a CCD image sensor at the distal end of the endoscope arranged with a rotary RGB color-filter. (Ex. 1006 at 8:16-19, 8:24-53, 8:62-9:3, 11:4-58, Fig. 1; Gunday at ¶¶329.) The CCD image sensor converts the focused endoscope image into frames of red, green and blue analog image-pixel signals, indicating that it produces images from pixels that are sensitive to different wavelengths of light. (Ex. 1006 at 8:42-44, 9:23-32; Gunday at ¶¶329.)

Second, Ozawa discloses "*an image processor coupled to receive signals* *produced by the color image sensor in response to illumination light reflected from the tissue having red, green, and blue color components*." Ozawa discloses that "the [red, green, and blue] image-pixel signals [read from the CCD image sensor 18] are fed to an image-signal processor." (Ex. 1006 at 8:42-48; Gunday at ¶¶330-32.)

Third, Ozawa discloses "*wherein, the image processor calculates image signals that are stored in a memory by minimizing the contribution from signals produced by the image sensor in response to red illumination light*." Ozawa's image-signal processor provides a "video signal . . . based on the image-pixel signals," then "the video signal is fed from the image-signal processor to the TV monitor 14, and the endoscope image, sensed by the CCD image sensor 18, is reproduced as a motion picture on the TV monitor 14." (Ex. 1006 at 8:48-53, 11:43-52.) "[W]hile the SDS display mode is selected, the endoscope image is observed on the TV monitor 14 as if it were sprayed with a blue-solution, due to the color-balance alteration process of the red and green digital image-pixel signals in the color-balance alteration circuit 44[.]" (*Id.* at 11:51-58). The color-balance alteration process produces this bluish short wavelength image by minimizing the contribution of the red and green illumination light received from the image sensor. (*Id.* at 16:31-45; Gunday at ¶¶333-34.) Ozawa's images are necessarily stored in memory in order to be processed in different modes and fed into the TV monitor's input. (Gunday at ¶¶46, 50, 52, 68.) Ozawa therefore anticipates claim 1.

2. Independent Claim 10

First, Ozawa discloses *"[a]n imaging system for generating white light images and short wavelength visible images of tissue in response to a broad band illumination light that is delivered to a tissue sample and providing those images to one or more color video monitors*." This is the same system in Ozawa that anticipates claim 1 as set forth above. (Gunday at ¶¶335.) The images generated by that system include "full color image[s]" (i.e. white light images) and "bluish endoscope image[s]" (i.e. short wavelength visible images). (Ex. 1006 at 1:9-13, 16:31-39; 11:51-58, 16:39-45; Gunday at ¶¶336.) As discussed above, Ozawa discloses that its images are generated in response to a broadband illuminating light created by a "white light lamp 24" and delivered to a patient's organ. (Ex. 1006 at 8:54-56, 18:50-55.) This light source device radiates broadband illuminating light onto an object in an organ of a patient (i.e. tissue) via a rotating RGB color filter and a POSITA would consider the resultant red, green, and blue fields of light to be broadband illumination light as RGB light covers the full spectrum of visible light. (*Id.* at Fig 1 (items 24, 30, 8:62-9:3; Gunday at ¶¶337-41.)

Second, Ozawa discloses "*an image sensor that receives reflected light from the tissue sample, the image sensor having a number of pixels sensitive to different wavelengths of light and which generate image signals in response to the light received from the tissue sample*." Ozawa's image sensor is a "sold-state image sensor 18," and "[w]hen the flexible conduit 16 of the video scope 10 is inserted in an organ of a patient, an illuminated object is focused as an optical endoscopic image on a light-receiving surface of the CCD image sensor 18[.]" (Ex. 1006 at 8:39-42.) The pixels of Ozawa's image sensor are sensitive to red, blue, and green light wavelengths and in response to receiving those wavelengths the image sensor converts them into analog image-pixel signals. (Ex. 1006 at 8:42-44, 8:62-9:3, Fig. 1, 9:23-32; Gunday at ¶¶342-45.)

Third, Ozawa discloses "*an image processor that receives a set of image signals from the image sensor and produces a white light image of the tissue sample from the set of image signals and a short wavelength image of the tissue sample from a subset of the image signals*." As discussed above, Ozawa discloses that the analog image-pixel signals from the image sensor are fed to an image-signal processor. (Ex. 1006 at 8:42-48.) In the "usual display mode," the image that is produced by Ozawa's system is the proper color balanced image that was sensed by the CCD image sensor 18 (i.e. a white light image). (Ex. 1006 at 8:48-53, 11:43-52; Gunday at ¶¶346-47.) In "SDS display mode," the image observed on the monitor appears "as if it were sprayed with a blue solution, due to the color-balance alteration process of the red and green digital image-pixel signals in the color-balance alteration circuit 44[.]" (Ex. 1006 at 11:51-58; Gunday at ¶347). In other words, in the SDS display mode a short wavelength image is produced from a subset of the signals received from the image sensor. (*Id.*)

Fourth, Ozawa discloses "wherein the short wavelength image of the tissue is produced by substantially eliminating a contribution of red light in the set of image signals." For example, the "bluish" image created by Ozawa's system in the SDS display mode results from the system's minimization of the red and green image-pixel signals in proportion to absolute values of certain red and green difference signals, while the blue image-pixel signals are correspondingly increased. (Ex. 1006 at 16:31-45, 15:3-6, 17:3-4, 17:4-7; Gunday at ¶¶348-50.) Ozawa therefore anticipates claim 10.

3. Dependent Claim 11

Ozawa discloses *"[t]he system of claim 10, wherein the image sensor is located at the distal end of an endoscope*." The solid-state image sensor 18 in Ozawa is located "at the distal end" of the electronic endoscope system's video scope 10. (Ex. 1006 at 8:8-9, 8:15-19, Fig. 1 (item 18); Gunday at ¶¶351-52.) Ozawa therefore anticipates claim 11.

4. Dependent Claim 13

Ozawa discloses *"[t]he system of claim 10, wherein the image sensor is an RGB sensor*." Ozawa's RGB image sensor comprises the solid-state CCD image sensor 18 arranged with the rotary-color filter 30, which causes red, green, and blue endoscope images to be sequentially and cyclically focused on the light-receiving surface of the CCD image sensor 18. (Ex. 1006 at 9:15-18.) "Each of the red, green, and blue images is converted into a frame of monochromatic (red, green, blue) analog image-pixel signals by the CCD image sensor 18." (*Id.* at 9:15-28; Gunday at ¶¶353-55.) A POSITA would therefore consider the above arrangement to be an RGB sensor. (Gunday at ¶354.) Ozawa therefore anticipates claim13.

5. Dependent Claim 15

Ozawa discloses "*[t]he system of claim 10, wherein the image processor has sufficient processing speed and a display memory to process and provide for display both a white light image and a short wavelength image within a video frame*." Ozawa's system is capable of generating both full color (white light) images and bluish (short wavelength images) by switching between different display modes, and such images may be displayed simultaneously on the same monitor or on separate monitors. (Ex. 1006 at 11:51-58, 16:31-45, 20:64 – 21:4, 29:46-51; Gunday at ¶¶356-60.) A POSITA would understand this to mean that Ozawa's system necessarily includes a processor with sufficient processing speed and display memory to provide a white light and short wavelength image within a video frame. (*Id.*) Ozawa therefore anticipates claim 15.

6. Dependent Claim 16

Ozawa discloses "*[t]he system of claim 15, wherein the white light image and the short wavelength image are simultaneously displayed on the same color video monitor*." As discussed above, Ozawa discloses that the SDS endoscope image and the full color endoscope image can be simultaneously displayed on one monitor. (Ex. 1006 at 20:64 – 21:4; Gunday at ¶¶361-64.) Ozawa therefore anticipates claim 16.

7. Dependent Claim 17

Ozawa discloses "*[t]he system of claim 15, wherein the white light image* *and the short wavelength image are simultaneously displayed on two separate color video monitors*." As discussed above, Ozawa discloses that the SDS endoscope image and the full color endoscope image can be simultaneously displayed two separate monitors. (Ex. 1006 at 29:46-51; Gunday at ¶¶365-67.) Ozawa therefore anticipates claim 17.)

VIII. Conclusion

Petitioner respectfully requests the Board's institution of an *inter partes* review of claims 1-17 of the '151 patent, and a finding that those claims are unpatentable.

Respectfully submitted,

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/s/ Wesley W. Whitmyer, Jr.

Wesley W. Whitmyer, Jr. (Reg. No. 33,558)
Michael J. Kosma (Reg. No. 70,169)
Michael A. Lavine (Reg. No. 69,917)
WHITMYER IP GROUP LLC
600 Summer Street
Stamford, CT 06901
Tel: 203 703-0800
Fax: 203 703-0801
litigation@whipgroup.com

CERTIFICATE OF SERVICE

I hereby certify that true and correct copies of the foregoing Petition for *Inter Partes* Review of U.S. Patent 7,420,151 and Exhibits 1001-1015 were served on September 1, 2015 by FedEx delivery on the following:

Julian D. Forman
Novadaq Technologies Inc.
13155 Delf Place
Unit #250
Richmond BC V6V 2A2

Jennifer Lee Taylor
MORRISON & FOERSTER LLP
425 Market Street
San Francisco, California 94105-2482
JTaylor@mofo.com

/s/ Wesley W. Whitmyer, Jr.
Wesley W. Whitmyer, Jr. (Reg. No. 33,558)
WHITMYER IP GROUP LLC
600 Summer Street
Stamford, CT 06901
Tel: 203 703-0800
Fax: 203 703-0801
litigation@whipgroup.com