

High Resolution Imaging Ground Penetrating Radar Design and Simulation

Charles Phillip Saunders II

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State
University in partial fulfillment of the requirements for the degree of

Master of Science in Mechanical Engineering

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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 1-1. The ODIS landmine detection system, being pushed by a small vehicle. Source: Borgwardt, C. (1996). High-precision mine detection with real-time imaging. , 2765(1) doi:10.1117/12.241232

Report generated on: 04-02-2014 at : 15:56:33

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use*



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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 1-2. A 5 meter strip of real-time generated ODIS output. Source: Borgwardt, C. (1996). High-precision mine detection with real-time imaging. , 2765(1) doi:10.1117/12.241232

Report generated on: 04-02-2014 at : 15:59:09

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 1 3. The HILTI Ferroskan. Source: HILTI. (Photographer). (2009). HILTI Ferroskan [Web Photo]. Retrieved from <https://www.hilti.com/data/product/prodlarge/62304.jpg>

Report generated on: 04-02-2014 at : 16:21:12

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use*



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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 1 4. A PMN landmine, on the left, and the corresponding Ferrosan output, on the right. Source: Bruschini, C. (2000). Metal detectors in civil engineering and humanitarian demining: Overview and tests of a commercial visualizing system. Informally published manuscript, Institute of Electrical Engineering, School of Engineering, École Polytechnique Fédérale de Lausanne & Vrije Universiteit Brussel, Brussels, Belgium. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.72.9870&rep=rep1&type=pdf>

Report generated on: 04-02-2014 at : 16:25:01

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use*



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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 1 5. Sonar depth sounding, on the left, and sonar imaging, on the right, of a German Do 17 bomber. Source: Port of London Authority. (Photographer). (2013, June 03). Dornier Do 17 bomber [Web Photo]. Retrieved from http://eandt.theiet.org/news/2013/jun/images/640_german-plane-sonar-cropped.jpg

Report generated on: 04-02-2014 at : 16:22:36

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

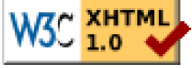
Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in*

favor of fair use



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Name: Charles Saunders

Description of item under review for fair use: Figure 1 5. Sonar depth sounding, on the left, and sonar imaging, on the right, of a German Do 17 bomber. Source: Port of London Authority. (Photographer). (2013, May 07). Dornier Do 17 bomber [Web Photo]. Retrieved from http://a57.foxnews.com/global.fncstatic.com/static/managed/img/Scitech/660/371/Possible Do17_Wessex Archaeology side scan.jpg?ve=1&tl=1

Report generated on: 04-02-2014 at : 16:23:45

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in*

favor of fair use



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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 1 6. GPR scans (above) and interpretation of (below) culverts under Fountains Abbey in North Yorkshire, UK. Source: Daniels, D. J., & Institution of Electrical Engineers. (2004). Ground penetrating radar. London: Institution of Engineering and Technology.

Report generated on: 04-02-2014 at : 16:26:57

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use*



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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 1 7. A Ditch Witch brand GPR unit. Source: Daniels, D. J., & Institution of Electrical Engineers. (2004). Ditch Witch. (Photographer). (2007, December). Ditch Witch 2450GR [Web Photo]. Retrieved from http://www.ditchwitch.com/sites/default/files/styles/popup/public/pictures/ditch-witch_2450GR_master_03.jpg

Report generated on: 04-02-2014 at : 16:28:02

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

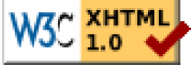
Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in*

favor of fair use



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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 4 3. A patch antenna. Source: Tan, Y. C. M., & Tan, Y. C. M. (2010). Computational modelling and simulation to design 60GHz mmWave antenna. 1-4. doi:10.1109/APS.2010.5562035

Report generated on: 04-02-2014 at : 16:30:01

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

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Virginia Tech ETD Fair Use Analysis Results

This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.

Name: Charles Saunders

Description of item under review for fair use: Figure 4 4. 60 GHz patch antenna radiation pattern. Source: Tan, Y. C. M., & Tan, Y. C. M. (2010). Computational modelling and simulation to design 60GHz mmWave antenna. 1-4. doi:10.1109/APS.2010.5562035

Report generated on: 04-02-2014 at : 16:31:44

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 4 5. NATO 5.56 casing dimensions. Source: Flinch, F. (Artist). (2010, November 19). 5.56 NATO Cartridge Dimensions [Web Drawing]. Retrieved from <http://ultimatereloader.com/tag/5-56-x-45mm/>

Report generated on: 04-02-2014 at : 16:32:46

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

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Virginia Tech ETD Fair Use Analysis Results

This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.

Name: Charles Saunders

Description of item under review for fair use: Figure 4 6. Slug lengths for different variations of the 5.56 round.
Source: Cooke, G. (Artist). (2005, May 03). 5.56 Ammo [Web Drawing]. Retrieved from http://www.inetres.com/gp/military/infantry/rifle/556mm_amm0.html

Report generated on: 04-02-2014 at : 16:34:24

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

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Name: Charles Saunders

Description of item under review for fair use: Figure 4 7. A 5.56 NATO casing and its simulation approximation.
Source: Flinch, F. (Artist). (2010, November 19). 5.56 NATO Cartridge Dimensions [Web Drawing]. Retrieved from <http://ultimatereloader.com/tag/5-56-x-45mm/>

Report generated on: 04-02-2014 at : 16:36:38

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

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Factor 4

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Virginia Tech ETD Fair Use Analysis Results

This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.

Name: Charles Saunders

Description of item under review for fair use: Figure 4 8. A complete 5.56 NATO round and the slug without a shell casing. Source: (2010, June 24). 5.56 M855A1 Enhanced Performance Round [Web Photo]. Retrieved from <http://usarmy.vo.llnwd.net/e1/-images/2011/05/08/107872/army.mil-107872-2011-05-06-190552.jpg>

Report generated on: 04-02-2014 at : 16:41:15

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 4 9. A pile of PMN landmines, found outside Fallujah, Iraq, in 2003. Source: Gaines, D. (Photographer). (2003, June 25). EOD personnel evaluating PMN mines in Fallujah, Iraq [Web Photo]. Retrieved from <http://www.dodmedia.osd.mil/Assets/2004/Army/DA-SD-04-02138.JPG>

Report generated on: 04-02-2014 at : 16:42:56

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

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Virginia Tech ETD Fair Use Analysis Results

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Name: Charles Saunders

Description of item under review for fair use: Figure 4 10. A Russian PMN landmine. Source: Trevelyan, J. (2000, January 01). Photographs of pmn-2 mine. Retrieved from <http://school.mech.uwa.edu.au/~jamest/demining/info/pmn-2.html>

Report generated on: 04-02-2014 at : 16:44:13

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

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Name: Charles Saunders

Description of item under review for fair use: Figure 4 11. A partially disassembled PMN landmine. Source: Trevelyan, J. (2000, January 01). Photographs of pmn-2 mine. Retrieved from <http://school.mech.uwa.edu.au/~jamest/demining/info/pmn-2.html>

Report generated on: 04-02-2014 at : 16:44:55

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Factor 1

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Factor 2

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