References

Andreas, F., Mats, G., and Sven, N. (2012). "Image reconstruction in microwave tomography using a dielectric Debye model." *IEEE Transactions on Biomedical Engineering*, 59(1), 156–166.

Andrew, W. (2012). "Increasing the sensitivity of magnetic resonance spectroscopy and imaging." *Analytical Chemistry*, 84(1), 9–16.

Assmus, A. (1995). "Early history of X-rays." *Lie and Non-Lie Symmetries of Nonlinear Diffusion Equations with*, 25.

Badgwell, B.D., Giordano, S.H., Duan, Z.Z., Fang, S., Bedrosian, I., and Kuerer, H.M. (2008). "Mammography before diagnosis among women age 80 years and older with breast cancer." *Journal of Clinical Oncology*, 26(15), 2482–2488.

Bech, M., Jensen, T.H., Bunk, O., Donath, T., David, C., and Weitkamp, T. (2010). "Advanced contrast modalities for X-ray radiology: Phase-contrast and dark-field imaging using a grating interferometer." *Zeitschrift Für Medizinische Physik*, 20(1), 7–16.

Bihan, D.L., Mangin, J.F., Poupon, C., Clark, C.A., Pappata, S., Molko, N. (2001). "Diffusion tensor imaging: Concepts and applications." *Journal of Magnetic Resonance Imaging*, 13(4), 534–546.

Bindu, G., and Mathew, K.T. (2007). "Characterization of benign and malignant breast tissues using 2-D microwave tomographic imaging." *Microwave & Optical Technology Letters*, 49(10), 2341–2345.

Board, A.D.A.M.E. (2011). Arm CT scan. A.D.A.M.

Bond, E.J., Li, X., Hagness, S.C., and Van Veen, B.D. (2003). "Microwave imaging via space-time beamforming for early detection of breast cancer." *IEEE Transactions on Antennas & Propagation*, 51(8), 1690–1705.

Born, M., and Wolf, E. (1980). *Principles of Optics*. Pergamon Press, Sixth Edition, Chapter 10.4.2, 510.

Broquetas, A., Romeu, J., Rius, J.M., Elias-Fuste, A.R., Cardama, A., and Jofre, L. (1991). "Cylindrical geometry: A further step in active microwave tomography." *IEEE Transactions on Microwave Theory & Techniques*, 39(5), 836–844.

Cercignani, M., and Horsfield, M.A. (2001). "The physical basis of diffusion-weighted MRI." *Journal of the Neurological Sciences*, 186(1), S11–S14.

Chan, V., and Perlas, A. (2011). *Basics of Ultrasound Imaging*. Springer New York.

Colin, G., Puyan, M., Amer, Z., Majid, O., Cameron, K., and Sima, N. et al. (2010). "A wideband microwave tomography system with a novel frequency selection procedure." *IEEE Transactions on Biomedical Engineering*, 57(4), 894–904.

Craddock, I.J., Preece, A., Leendertz, J., Klemm, M., Nilavalan, R., and Benjamin, R. (2006). "Development of a hemi-spherical wideband antenna array for breast cancer imaging." *2006 European Conference on Antennas and Propagation EUCAP*, 6–10.

David, G., and Bruce, M. (2007). "MRI evaluation of breast cancer." *New England Journal of Medicine*, 357(2), 191–193.

Davis, T.J., Gao, D., Gureyev, T.E., Stevenson, A.W., and Wilkins, S.W. (1995). "Phase-contrast imaging of weakly absorbing materials using hard X-rays." *Nature*, 373(6515), 595–598.

Deighton, A.M. (2013). "Differentiating between healthy and malignant lymph nodes at microwave frequencies." *Undergrad. Res. Alberta*, 3(1).

Demi, M. (2014). "The basics of ultrasound." *Comprehensive Biomedical Physics*, 57(9), 297–322.

Dorria Saleh, S., Rasha Mohamed, K., Sahar Mahmoud, M., Lamiaa Adel, S., and Rasha, W. (2013). "Breast imaging in the young: The role of magnetic resonance imaging in breast cancer screening, diagnosis and follow-up." *Journal of Thoracic Disease*, 5 suppl 1(2), S9–S18.

Eleuterio, R., and Conceicao, R.C. (2015). "Initial study for detection of multiple lymph nodes in the axillary region using Microwave Imaging." *9th European Conference on Antennas and Propagation (EuCAP)*.

Elmore, J.G., Barton, M.B., Moceri, V.M., Polk, S., Arena, P.J., and Fletcher, S.W. (1998). "Ten-year risk of false positive screening mammograms and clinical breast examinations." *The New England Journal of Medicine*, 43(5), 1089–1096.

Epstein, N.R., Meaney, P.M., and Paulsen, K.D. (2014). "3D parallel-detection microwave tomography for clinical breast imaging." *Review of Scientific Instruments*, 85(12), 124704-124704-12.

Fear, E.C., and Stuchly, M.A. (2000). "Microwave breast cancer detection." *IEEE MTT-S International Microwave Symposium*, 2, pp. 1037–1040.

Fear, E.C., Hagness, S.C., Meaney, P.M., and Okoniewski, M. (2002a). "Enhancing breast tumor detection with near-field imaging." *IEEE Microwave Magazine*, 3(1), 48–56.

Fear, E.C., Sill, J., and Stuchly, M.A. (2003). "Experimental feasibility study of confocal microwave imaging for breast tumor detection." *IEEE Transactions on Microwave Theory & Techniques*, 51(3), 887–892.

Fear, E.C., Xu, L., Hagness, S.C., and Stuchly, M.A. (2002b). "Confocal microwave imaging for breast cancer detection: Localization of tumors in three dimensions." *IEEE Transactions on Biomedical Engineering*, 49(8), 812–822.

Ferrara, K.W., Borden, M.A., and Zhang, H. (2009). "Lipid-shelled vehicles: Engineering for ultrasound molecular imaging and drug delivery." *Accounts of Chemical Research*, 42(7), 881–892.

Foster, K.R., and Schwan, H.P. (1989). "Dielectric properties of tissues and biological materials: A critical review." *Critical Reviews in Biomedical Engineering*, 17(17), 25–104.

Gabriel, C., Gabriel, S., and Corthout, E. (1996a). "The dielectric properties of biological tissues: I. literature survey." *Physics in Medicine & Biology*, 41(11), 2231–2249.

Gabriel, S., Gabriel, C., and Lau, R.W. (1996b). "The dielectric properties of biological tissues: III parametric models for the dielectric spectrum of tissues." *Physics in Medicine & Biology*, 41(11), 2271–2293.

Go, A.S., Mozaffarian, D., Roger, V.L., Benjamin, E.J., Berry, J.D., Borden, W.B., and Turner, M.B. (2013). "Heart disease and stroke statistics—2013 update a report from the American Heart Association." *Circulation*, 127, e6–e245.

Hagness, S.C., Taflove, A., and Bridges, J.E. (1998). "Two-dimensional FDTD analysis of a pulsed microwave confocal system for breast cancer detection: Fixed-focus and antenna-array sensors." *IEEE Transactions on Biomedical Engineering*, 47(5), 783–791.

Hagness, S.C., Taflove, A., and Bridges, J.E. (1999). "Three-dimensional FDTD analysis of an ultra-wide band antenna-array element for confocal microwave imaging of nonpalpable breast tumors." *Antennas and Propagation Society International Symposium*, 3, 1886–1889.

Haidekker, M.A., and Dougherty, G. (2011). *Medical Imaging in the Diagnosis of Osteoporosis and Estimation of the Individual Bone Fracture Risk*. Springer Berlin.

Haidekker, M.A. (2013a). *Magnetic Resonance Imaging. Medical Imaging Technology*. Springer New York.

Haidekker, M.A. (2013b). *Medical Imaging Technology*. Springer New York.

Halter, R.J., Zhou, T., Meaney, P.M., Hartov, A., Barth, R.J. Jr, Rosenkranz, K.M., Wells, W.A., Kogel, C.A., Borsic, A., Rizzo, E.J., and Paulsen, K.D. (2009). "The correlation of in vivo and ex vivo tissue dielectric properties to validate electromagnetic breast imaging: initial clinical experience." *Physiological Measurement*, 30(6), S121–S136.

Harrington, R.F. (1993). *Field Computation by Moment Methods*. Wiley-IEEE Press.

Heil, J., Czink, E., Schipp, A., Sohn, C., Junkermann, H., and Golatta, M. (2012). "Detected, yet not diagnosed—Breast cancer screening with MRI mammography in high-risk women." *Breast Care*, 7(3), 236–239.

Henriksson, T., Klemm, M., Gibbins, D., and Leendertz, J. (2011). "Clinical trials of a multistatic UWB radar for breast imaging." *2011 Loughborough Antennas and Propagation Conference (LAPC)*, pp. 1–4.

Hou, M.F., Chuang, H.Y., Ou, Y.F., Wang, C.Y., Huang, C.L., and Fan, H.M. (2002). "Comparison of breast mammography, sonography and physical examination for screening women at high risk of breast cancer in Taiwan." *Ultrasound in Medicine & Biology*, 28(4), 415–420.

Huynh, P.T., Jarolimek, A.M., and Daye, S. (1998). "The false-negative mammogram." *Radiographics*, 18(5), 1137–1154.

Ibrahim, W.M.A., and Algabroun, H.M. (2008). "The Family Tree of Breast Microwave Imaging Techniques." *4th Kuala Lumpur International Conference on Biomedical Engineering. Springer Berlin Heidelberg*.

Jackson, V.P., Hendrick, R.E., Feig, S.A., and Kopans, D.B. (1993). "Imaging of the radiographically dense breast." *Radiology*, 188(2), 297–301.

Jacobi, J.H., and Larsen, L.E. (1978). "Microwave interrogation of dielectric targets. Part II: By microwave time delay spectroscopy." *Medical Physics*, 5(6), 509–513.

Jacobs, M.A., Ibrahim, T.S., and Ouwerkerk, R. (2007). "MR imaging: Brief overview and emerging applications1." *Radiographics*, 27(4), 1213–1229.

John, S., Mark, H., Paul, C., and Mahta, M. (2012). "A preclinical system prototype for focused microwave thermal therapy of the breast." *IEEE Transactions on Biomedical Engineering*, 59(9), 2431–2438.

Joines, W.T., Zhang, Y., Li, C., and Jirtle, R.L. (1994). "The measured electrical properties of normal and malignant human tissues from 50 to 900 MHz." *Medical Physics*, 21(4), 547–550.

Kalender, W.A., and Quick, H.H. (2011). "Recent advances in medical physics." *European Radiology*, 21(3), 501–504.

Kamal, R.M., Razek, N.M.A., Hassan, M.A., and Shaalan, M.A. (2007). "Missed breast carcinoma; why and how to avoid?" *Journal of the Egyptian National Cancer Institute*, 19(3), 178–194.

Keen, J.D., and Keen, J.E. (2008). "How does age affect baseline screening mammography performance measures? A decision model." *BMC Medical Informatics & Decision Making*, 8(22), 40.

Kiessling, F., Fokong, S., Koczera, P., Lederle, W., and Lammers, T. (2012). "Ultrasound microbubbles for molecular diagnosis, therapy, and theranostics." *Journal of Nuclear Medicine*, 53(3), 345–348.

Klemm, M., Gibbins, D., Leendertz, J., and Horseman, T. (2011). "Development and testing of a 60-element UWB conformal array for breast cancer imaging." *Proceedings of the 5th European Conference on Antennas and Propagation (EUCAP)*, 3077–3079.

Klemm, M., Leendertz, J.A., Gibbins, D., Craddock, I.J., Preece, A., and Benjamin, R. (2010). "Microwave radar-based differential breast cancer imaging: Imaging in homogeneous breast phantoms and low contrast scenarios." *IEEE Transactions on Antennas & Propagation*, 58(7), 2337–2344.

Kurrant, D.J., Fear, E.C., and Westwick, D.T. (2008). "Tumor response estimation in radar-based microwave breast cancer detection." *IEEE Transactions on Biomedical Engineering*, 55(55), 2801–2811.

Larsen, L.E., and Jacobi, J.H. (1978). "Microwave interrogation of dielectric targets. Part I: By scattering parameters." *Medical Physics*, 5(6), 500–508.

Larsen, L.E., and Jacobi, J.H. (1986). *Medical Applications of Microwave Imaging*. IEEE Press.

Lazebnik, M., Okoniewski, M., Booske, J.H., and Hagness, S.C. (2007a). "Highly accurate Debye models for normal and malignant breast tissue dielectric properties at microwave frequencies." *IEEE Microwave & Wireless Components Letters*, 17(12), 822–824.

Lazebnik, M., Popovic, D., Mccartney, L., Watkins, C., Lindstrom, M., and Harter, J. (2007b). "A large-scale study of the ultrawideband microwave dielectric properties of normal, benign and malignant breast tissues obtained from cancer surgeries." *Physics in Medicine & Biology*, 52(20), 6093–6115.

Levanda, R., and Leshem, A. (2010). "Synthetic aperture radio telescopes." *IEEE Signal Processing Magazine*, 27(1), 14–29.

Li, X., and Hagness, S.C. (2001). "A confocal microwave imaging for breast cancer detection." *IEEE Microwave & Wireless Components Letters*, 11(3), 130–132.

Li, X., Davis, S.K., Hagness, S.C., Van, D.W.D.W., and Van Veen, B.D. (2004). "Microwave imaging via space-time beam forming: Experimental investigation of tumor detection in multilayer breast phantoms." *IEEE Transactions on Microwave Theory & Techniques*, 52(8), 1856–1865.

Magland, J.F., Wald, M.J., and Wehrli, F.W. (2009). "Spin-echo micro-MRI of trabecular bone using improved 3D fast large-angle spin-echo (flase)." *Magnetic Resonance in Medicine*, 61(61), 1114–1121.

Margarido, C., Arzola, C., MrinaliniBalki, and Carvalho, J.A. (2010). "No McCollough effect in a patient with cerebral achromatopsia but spared v1." *Journal of Vision*, 8(6), 489–489.

Meaney, P.M., Douglas, G., Golnabi, A.H., Tian, Z., Matthew, P., and Geimer, S.D. (2012a). "Clinical microwave tomographic imaging of the calcaneus: A first-in-human case study of two subjects." *IEEE Transactions on Biomedical Engineering*, 59(12), 3304–3313.

Meaney, P.M., Fanning, M.W., Raynolds, T., Fox, C.J., Fang, Q., and Kogel, C.A. (2007). "Initial clinical experience with microwave breast imaging in women with normal mammography." *Academic Radiology*, 14(2), 207–218.

Meaney, P.M., Zhou, T., Goodwin, D., Golnabi, A., Attardo, E.A., and Paulsen, K.D. (2012b). "Bone dielectric property variation as a function of mineralization at microwave frequencies." *International Journal of Biomedical Imaging*, 2012, 649612.

Mohammed, B.A.J., Abbosh, A.M., Ireland, D., and Bialkowski, M.E. (2012). "Compact wideband antenna for microwave imaging of brain." *Progress in Electromagnetics Research C*, 27, 27–39.

Muir, K.W., Buchan, A., von Kummer, R., Rother, J., and Baron, J.C. (2006). "Imaging of acute stroke." *The Lancet Neurology*, 5, 755–768.

Nikolova, N.K. (2011). "Microwave imaging for breast cancer." *IEEE Microwave Magazine*, 12(12), 78–94.

Ogawa, S., Lee, T.M., Kay, A.R., and Tank, D.W. (1990). "Brain magnetic resonance imaging with contrast dependent on blood oxygenation." *Proceedings of the National Academy of Sciences of the United States of America*, 87(24), 9868–9872.

O'Halloran, M., Conceicao, R.C., Byrne, D., Glavin, M., and Jones, E. (2009). "FDTD modeling of the breast: A review." *Progress in Electromagnetics Research B*, 18, 1–24.

O'Rourke, A.P., Mariya, L., Bertram, J.M., Converse, M.C., Hagness, S.C., and Webster, J.G. (2007). "Dielectric properties of human normal, malignant and cirrhotic liver tissue: In vivo and ex vivo measurements from 0.5 to 20 GHz using a precision open-ended coaxial probe." *Physics in Medicine and Biology*, 52(15), 4707–4719.

Pethig, R. (1984). "Dielectric properties of biological materials: Biophysical and medical applications." *IEEE Transactions on Electrical Insulation*, ei-19(5), 453–474.

Pfeiffer, F., Bech, M., Bunk, O., Kraft, P., Eikenberry, E.F., and Ch, B. et al. (2008). "Hard-x-ray dark-field imaging using a grating interferometer." *Nature Materials*, 7(2), 134–137.

Piccoli, C.W. (1997). "Contrast-enhanced breast MRI: Factors affecting sensitivity and specificity." *European Radiology*, 7(5), S281–S288.

Pichot, C., Jofre, L., Peronnet, G., and Bolomey, J.C. (1985). "Active microwave imaging of inhomogeneous bodies." *IEEE Transactions on Antennas & Propagation*, 33(4), 416–425.

Prinz, C., and Voigt, J.U. (2011). "Diagnostic accuracy of a hand-held ultrasound scanner in routine patients referred for echocardiography." *Journal of the American Society of Echocardiography*, 24(2), 111–116.

Radon, J. (1917). "Über die bestimmung von funktionen durch ihre in-te-gral-werte längs gewisser mannigfaltigkeiten." *Computed Tomography*, 69, 262–277.

Ron, E. (2003). "Cancer risks from medical radiation." *Health Physics*, 85(1), 47–59.

Rubæk, T. (2008). "Microwave imaging for breast-cancer screening." PhD Thesis.

Sadigh, G., Kelly, A.M., Fagerlin, A., and Carlos, R.C. (2011). "Patient preferences in breast cancer screening." *Academic Radiology*, (11), 1333–1336.

Said, T., and Varadan, V.V. (2009). "Variation of Cole-Cole model parameters with the complex permittivity of biological tissues," 2009. MTT '09. *IEEE International Microwave Symposium Digest MTT-S*, pp. 1445–1448.

Salvador, S.M., Fear, E.C., Okoniewski, M., and Matyas, J.R. (2010). "Exploring joint tissues with microwave imaging." *IEEE Transactions on Microwave Theory & Techniques*, 58(8), 2307–2313.

Scapaticci, R., Di Donato, L., Catapano, I., and Crocco, L. (2012). "A feasibility study on microwave imaging for brain stroke monitoring." *Progress in Electromagnetics Research B*, 40, 305–324.

Schepps, J.L., and Foster, K.R. (1980). "The uhf and microwave dielectric properties of normal and tumour tissues: Variation in dielectric properties with tissue water content." *Physics in Medicine & Biology*, 25(6), 1149–1159.

Semenov, S. (2009). "Microwave tomography: Review of the progress towards clinical applications." *Philosophical Transactions*, 367(1900), 3021–3042.

Semenov, S.Y., Svenson, R.H., Boulyshev, A.E., Souvorov, A.E., Borisov, V.Y., and Sizov, Y. (1996). "Microwave tomography: Two-dimensional system for biological imaging." *IEEE Transactions on Biomedical Engineering*, 43(9), 869–877.

Semenov, S.Y., Svenson, R.H., Bulyshev, A.E., Souvorov, A.E., Nazarov, A.G., and Sizov, Y.E. (2000). "Microwave spectroscopy of myocardial ischemia and infarction. 2. biophysical reconstruction." *Annals of Biomedical Engineering*, 28(1), 48–54.

Sha, L., Ward, E.R., and Stroy, B. (2002). "A review of dielectric properties of normal and malignant breast tissue." *SoutheastCon, 2002. Proceedings IEEE*, 457–462.

Silver, S. (1984). "Radiation from current distributions. Microwave Antenna Theory and Design." *IET Digital Library*.

Smart, C.R. (1997). "Limitations of the randomized trial for the early detection of cancer." *Cancer*, 79(9), 1740–1746.

Smith, D., Leach, M., and Kellner, A. (2004). "Indirect holographic imaging of antennas using an electronically synthesised 'slow-wave.'" *Antennas and Propagation Society International Symposium*, 1, 703–706.

Smith, D., Yurduseven, O., Livingstone, B., and Schejbal, V. (2014). "Microwave imaging using indirect holographic techniques." *IEEE Antennas & Propagation Magazine*, 56(1), 104–117.

Sunaga, T., Ikehira, H., Furukawa, S., Skinkai, H., Kobayashi, H., and Matsumoto, Y. (2002). "Measurement of the electrical properties of human skin and the variation among subjects with certain skin conditions." *Physics in Medicine & Biology*, 47(1), N11–N15(5).

Tilman, D., Franz, P., Oliver, B., Christian, G., Eckhard, H., and Stefan, P. (2010). "Toward clinical x-ray phase-contrast CT: Demonstration of enhanced soft-tissue contrast in human specimen." *Investigative Radiology*, 45(7), 445–52.

Wang, L., Simpkin, R., and Al-Jumaily, A.M. (2013a). "Holographic microwave imaging for medical applications." *Journal of Biomedical Science & Engineering*, 6(8), 823–833.

Wang, L., Al-Jumaily, A.M., and Simpkin, R. (2013b). "Holographic microwave imaging array for brain stroke detection." *Journal of Signal & Information Processing*, 4(3B), 96–101.

Wang, L., Simpkin, R., and Al-Jumaily, A.M. (2013c). "Open-ended waveguide antenna for microwave breast cancer detection." *2013 IEEE International Workshop on Electromagnetics (iWEM)*, 65–68.

Wang, L., Al-Jumaily, A.M., and Simpkin, R. (2014a). "Imaging of 3-D dielectric objects using far-field holographic microwave imaging technique." *Progress in Electromagnetics Research B*, 61, 135–147.

Wang, L., Simpkin, R., and Al-Jumaily, A.M. (2014b). "Three-dimensional far-field holographic microwave imaging: An experimental investigation of dielectric object." *Progress in Electromagnetics Research B*, 61, 169–184.

Wang, L., Al-Jumaily, A.M., and Simpkin, R. (2015). "Investigation of antenna array configurations using far-field holographic microwave imaging technique." *Progress in Electromagnetics Research M*, 42, 1–11.

Wehrli, F.W., Saha, P.K., Gomberg, B.R., Hee Kwon, S., Snyder, P.J., and Maria, B. (2002). "Role of magnetic resonance for assessing structure and function of trabecular bone." *Topics in Magnetic Resonance Imaging TMRI*, 13(5), 335–355.

Weitkamp, T. (2006). "Phase retrieval and differential phase-contrast imaging with low-brilliance X-ray sources." *Nature Physics*, 2(4), 258–261.

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