# Table of Contents

## Breast Density

A New Step-Wedge for the Volumetric Measurement of Mammographic Density  
*Jennifer Diffey, Alan Hufton, Susan Astley*  ............................................. 1

Assessing Ground Truth of Glandular Tissue  
*Christina Olsen, Fredrik Georgsson*  ............................................................. 10

Volumetric Breast Density Estimation on Mammograms Using Breast Tissue Equivalent Phantoms – An Update  
*Bindu J. Augustine, Gordon E. Mawdsley, Norman F. Boyd, Martin J. Yaffe*  ................................................................. 18

An Alternative Approach to Measuring Volumetric Mammographic Breast Density  
*Christopher Tromans, Michael Brady*  ......................................................... 26

Breast Density Dependent Computer Aided Detection  
*Styliani Petroudi, Michael Brady*  ..................................................................... 34

Evaluation of Effects of HRT on Breast Density  
*Styliani Petroudi, Kostantinos Marias, Michael Brady*  ..................................... 39

## CAD

Modeling the Effect of Computer-Aided Detection on the Sensitivity of Screening Mammography  
*Robert M. Nishikawa*  ...................................................................................... 46

Use of Prompt Magnitude in Computer Aided Detection of Masses in Mammograms  
*Nico Karssemeeijer*  .......................................................................................... 54

Current Screening Practice: Implications for the Introduction of CAD  
*Lucy Tomlinson, Nathalie Hurley, Caroline Boggis, Julie Morris, Emma Hurley, Sue Astley*  ......................................................... 61

Mammographic Mass Detection Using Unsupervised Clustering in Synergy with a Parcimonious Supervised Rule-Based Classifier  
*Michel Bruynooghe*  .......................................................................................... 68
Computerized Classification Can Reduce Unnecessary Biopsies in BI-RADS Category 4A Lesions
Isaac Leichter, Richard Lederman, Shalom Buchbinder, Yossi Srou, Philippe Bamberger, Fanny Sperber

Addressing Image Variability While Learning Classifiers for Detecting Clusters of Micro-calcifications
Glen Fung, Balaji Krishnapuram, Nicolas Merlet, Eli Ratner, Philippe Bamberger, Jonathan Stoeckel, R. Bharat Roo

Computer-Aided Detection of Breast Cancer Using an Ultra High-Resolution Liquid Crystal Display: Reading Session Analysis
Yoshifumi Kuroki, Shigeru Nawano, Hidefumi Kobalake, Nachiko Uchigama, Kazuo Shimura, Kouji Matano

Clinical Practice

Mammography Reading with Computer-Aided Detection (CAD): Performance of Different Readers

The Impact of Integration of Computer-Aided Detection and Human Observers
Nachiko Uchigama, Noriyuki Moriyama, Takayuki Yamada, Noriaki Ohuchi

Improving Access to Mammography in Rural Areas
Elizabeth A. Krupinski

Dual Modality Surgical Guidance for Non-palpable Breast Lesions
Patricia Judy Goodale, Priya Raghunathan, Mark B. Williams

Mammography Reading with Computer-Aided Detection (CAD): Single View vs Two Views
Automated Breast Tissue Measurement of Women at Increased Risk of Breast Cancer
H.G. Patel, S.M. Astley, A.P. Hutton, M. Harvie, K. Hagan,
T.E. Marchant, V. Hillier, A. Howell, R. Warren, C.R.M. Hoggis .... 131

Tomosynthesis

Mammography Tomosynthesis System for High Performance 3D Imaging
Jeffrey W. Eberhard, Douglas Albagli, Andrea Schmitz,
Bernhard E.H. Claus, Paul Carson, Mitchell Goodsitt,
Heang-Ping Chan, Marilyn Roubidoux, Jerry A. Thomas,
Jacqueline Osland ................................................................. 137

Clinical Evaluation of a Photon-Counting Tomosynthesis Mammography System
Andrew D.A. Maidment, Christer Ullberg, Tom Francke,
Lars Lindqvist, Skiff Sokolov, Karin Lindman, Leif Adelow,
Per Sunden ................................................................. 144

Three-Dimensional Digital Breast Tomosynthesis in the Early Diagnosis and Detection of Breast Cancer
Mari Vorjonen ................................................................. 152

Lesion Visibility in Low Dose Tomosynthesis
Andrew P. Smith, Loren Niklason, Baorui Ren, Tao Wu, Chris Ruth,
Zhenxue Jing ................................................................. 160

Generalized Filtered Back-Projection Reconstruction in Breast Tomosynthesis
Bernhard E.H. Claus, Jeffrey W. Eberhard, Andrea Schmitz,
Paul Carson, Mitchell Goodsitt, Heang-Ping Chan ......................... 167

Adaptation of Image Quality Using Various Filter Setups in the Filtered Backprojection Approach for Digital Breast Tomosynthesis
Jasmina Orman, Thomas Mertelmeier, Wolfgang Haerer ..................... 175

Optimization of Contrast-Enhanced Digital Breast Tomosynthesis
Ann-Katherine Carton, Jingjing Li, Sara Chen, Emily Conant,
Andrew D.A. Maidment ........................................................... 183

Development of an Analytic Breast Phantom for Quantitative Comparison of Reconstruction Algorithms for Digital Breast Tomosynthesis
I. Reiser, E.Y. Sidky, R.M. Nishikawa, X. Pan ............................... 190
# Table of Contents

## Registration and Multiple View Mammography

- **X-Ray Mammogram Registration: A Novel Validation Method**
  - John H. Hipwell, Christine Tanner, William R. Crum, David J. Hawkes ........................................ 197

- **A Probabilistic Approach for the Simultaneous Mammogram Registration and Abnormality Detection**
  - Mohamed Hackama, Agnès Desolneux, Frédéric Richard ................. 205

- **Mammographic Registration: Proposal and Evaluation of a New Approach**
  - Robert Martí, David Raba, Arnau Oliver, Reyer Zwiggelaar .......... 213

- **Image Similarity and Asymmetry to Improve Computer-Aided Detection of Breast Cancer**
  - Dave Tahmoush, Hanan Samet ........................................... 221

- **Potential Usefulness of Multiple-Mammographic Views in Computer-Aided Diagnosis Scheme for Identifying Histological Classification of Clustered Microcalcification**
  - Ryohi Nakayama, Ryoji Watanabe, Kiyoshi Namba, Koji Yamamoto, Kan Takeda, Shigehiko Katsuragawa, Kunio Doi ......................... 229

- **Exploitation of Correspondence Between CC and MLO Views in Computer Aided Mass Detection**
  - Saskia van Engeland, Nico Karssemeeijer ............................ 237

## Physics Models

- **Breast Composition Measurements Using Retrospective Standard Mammogram Form (SMF)**
  - Ralph Highnam, Xia-Bo Pan, Ruth Warren, Mona Jeffreys, George Davey Smith, Michael Brady .................................................. 243

- **A Scatter Model for Use in Measuring Volumetric Mammographic Breast Density**
  - Christopher Tromans, Michael Brady .................................. 251

- **Using a Homogeneity Test as Weekly Quality Control on Digital Mammography Units**
Automated and Human Determination of Threshold Contrast for Digital Mammography Systems
  
  Kenneth C. Young, James J.H. Cook, Jennifer M. Oduko ........................ 266

Beam Optimization for Digital Mammography – II
  
  Mark B. Williams, Priya Ragunathan, Anthony Seibert, Alex Kwan, Joseph Lo, Ehsan Samei, Laurie Fajardo, Andrew D.A. Maidment, Martin Yaffe, Ali Bloomquist .......................... 273

Image Qualities of Phase-Contrast Mammography
  
  Chika Honda, Hiromu Ohara, Tomonori Gido ................................. 281

Application of the Multiple Image Radiography Method to Breast Imaging
  
  Christopher Parham, Etta Pisano, Chad Livasy, Laura Faulconer, Miles Wernick, Jovan Brankov, Miklos Kiss, Dean Connor, Jeddy Chen, Ann Wu, Zhong Zhong, Dean Chapman .............................. 289

Correlating Cone-Beam CT and Large-Section Histology Image Sets: Initial Results Using a Surgical Lumpectomy Specimen
  
  James G. Mainprize, Shaista Okhai, Gina M. Clarke, Michael P. Kempston, Shawnee Eidit, Martin J. Yaffe ................................. 299

Poster Session

Calcification Descriptor and Relevance Feedback Learning Algorithms for Content-Based Mammogram Retrieval
  
  Chia-Hung Wei, Chang-Tsun Li .............................................. 307

Clinical Optimization of Filters in Direct a-Se FFDM (Full Field Digital Mammography) System
  
  Nachiko Uchiyama, Noriyuki Moriyama, Mayumi Kitagawa, Shiho Gomi, Yuichi Nagai .............................. 315

Study on Cascade Classification in Abnormal Shadow Detection for Mammograms
  
  Mitsutaka Nemoto, Akinobu Shimizu, Hidefumi Kobatake, Hideya Takeo, Shigeru Nawano .............................. 324

Classifying Masses as Benign or Malignant Based on Co-occurrence Matrix Textures: A Comparison Study of Different Gray Level Quantizations
  
  Gohert N. Lee, Takeshi Hara, Hiroshi Fujita .............................. 332
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Ranklet-Based CAD for Digital Mammography</td>
<td>Enrico Angelini, Renato Campanini, Emiro Iampieri, Nico Lanconelli, Matteo Masotti, Todor Petkov, Matteo Roffilli</td>
<td>340</td>
</tr>
<tr>
<td>Detection of Microcalcifications in Digital Mammograms Based on Dual-Threshold</td>
<td>Yuan Wu, Qian Huang, YongHong Peng, Wuchao Situ</td>
<td>347</td>
</tr>
<tr>
<td>Feasibility and Acceptability of Stepwedge-Based Density Measurement</td>
<td>Michael Berks, Jennifer Diffey, Alan Hufton, Susan Astley</td>
<td>355</td>
</tr>
<tr>
<td>Use of the European Protocol to Optimise a Digital Mammography System</td>
<td>Kenneth C. Young, James J.H. Cook, Jennifer M. Oduko</td>
<td>362</td>
</tr>
<tr>
<td>Automated Detection Method for Architectural Distortion with Spiculation Based on Distribution Assessment of Mammary Gland on Mammogram</td>
<td>Takeshi Hara, Takanari Makita, Tomoko Matsubara, Hiroshi Fujita, Yoriko Inenaga, Tokiko Endo, Takaji Iwase</td>
<td>370</td>
</tr>
<tr>
<td>Web Services for the DDSM and Digital Mammography Research</td>
<td>Chris Rose, Daniele Turi, Alan Williams, Katy Wolstencroft, Chris Taylor</td>
<td>376</td>
</tr>
<tr>
<td>GPCALMA: An Italian Mammographic Database of Digitized Images for Research</td>
<td>Adele Lauria, Raffaela Massafra, Sabina Sonia Tangaro, Roberto Bellotti, MariaEvelina Fantacci, Pasquale Delogu, Ernesto Lopez Torres, Piergiorgio Cervello, Francesco Fauci, Rosario Magro, Ubaldo Bottighi</td>
<td>384</td>
</tr>
<tr>
<td>Development of Breast Ultrasound CAD System for Screening</td>
<td>Daisuke Fukuoka, Yuji Ikedo, Takeshi Hara, Hiroshi Fujita, Etsuo Takada, Tokiko Endo, Takako Morita</td>
<td>392</td>
</tr>
<tr>
<td>Linking Image Structures with Medical Ontology Information</td>
<td>Da Qi, Erika R.E. Denton, Reyer Zwiggelaar</td>
<td>399</td>
</tr>
<tr>
<td>Comparison Between Wolfe, Boyd, BI-RADS and Tabár Based Mammographic Risk Assessment</td>
<td>Izzati Muhimmah, Arnau Oliver, Erika R.E. Denton, Josep Pont, Elsa Pérez, Reyer Zwiggelaar</td>
<td>407</td>
</tr>
</tbody>
</table>
Initial Results of the Daily Quality Control of Medical Screen Devices Using a Dynamic Pattern in a Digital Mammography Environment
   J. Jacobs, T. Deprez, G. Marchal, H. Bosmans ........................................... 416

A Filter-Based Approach Towards Automatic Detection of Microcalcification
   Zhi Qing Wu, Jianmin Jiang, Yong Hong Peng, Thor Ole Gulsrud .......................... 424

Texture Based Segmentation
   Reyner Zwiggelaar, Erik R.E. Denton ............................................................. 433

Image Quality of a Photon-Counting Mammography System Compared to Digital Mammography Based on Amorphous Silicon with CsI-Scintillator
   Arne Fischmann, Günther Steidle ................................................................. 441

Understanding Hessian-Based Density Scoring
   Jakob Raundahl, Marco Loog, Mads Nielsen ................................................... 447

Review of the Dose and Image Quality Characteristics of 3 FFDM Systems in Clinical Practice in a Screening Programme
   Gillian Egan, Niall Phelan ................................................................................. 453

Impact of Textured Background on Scoring of Simulated CDMAM Phantom
   Bénédicte Grosjean, Serge Muller ...................................................................... 460

Magnetic Resonance Electrical Impedance Mammography: A Pilot Study
   Maria Kallergi, Ernest Wollin, John J. Heine, Nataliya Kovalchuk, Anand Manohar ................................................................. 468

Experimental Investigation of the Necessity for Extra Flat Field Corrections in Quality Control of Digital Mammography
   Paula Pöyry, Federica Zanca, Hilde Bosmans ................................................... 475

Observer Evaluations of Wavelet Methods for the Enhancement and Compression of Digitized Mammograms
   Maria Kallergi, John J. Heine, Bradley J. Lucier ............................................... 482

Evaluating the Effect of Dose on Reconstructed Image Quality in Digital Tomosynthesis
   Michael P. Kempston, James G. Mainprize, Martin J. Yaffe .............................. 490
Registration of Mammograms and Breast Tomosynthesis Images
Predrag R. Bakić, Frederic J.P. Richard, Andrew D.A. Maidment ............................. 498

Complementary Role of Computer Aided Detection in Mammography
Keiko Sugisaki, Hiroshi Fujita, Hiro Goto, Hiroaki Hoshi ................................. 504

The Refinement of Microcalcification Cluster Assessment by Joint Analysis of MLO and CC Views
Márta Altrichter, Gábor Horváth ................................................................. 509

The Dependence of Tomosynthesis Imaging Performance on the Number of Scan Projections
Boorui Ren, Tao Wu, Andrew Smith, Chris Ruth, Loren Niklason, Zhenxue Jing, Jay Stein .......... 517

First Attempt at 3D X-Ray Visualization of DCIS (Ductal Carcinoma in Situ) Due to Refraction Contrast In Good Relation to Pathological View
Masami Ando, Takao Akatsuka, Hiroko Bando, Yoshimori Chikaura, Tokiko Endo, Eiko Hashimoto, Keiichi Hirano, Kazuyuki Hyodo, Shu Ichihara, Anton Maksimenko, Chiho Ohbayashi, Hiroshi Sugiyama, Ei Ueno, Katsuhito Yamasaki, Tetsuya Yuasa ........................................ 525

Wavelet Methods

Lossless Compression of Digital Mammograms
R. Visser, L. Oostveen, N. Karssemeijer ......................................................... 533

Capturing Microcalcification Patterns in Dense Parenchyma with Wavelet-Based Eigenimages
Nikolaos Arikidis, Spyros Skiadopoulos, Filippos Sakellaropoulos, George Panayiotakis, Lena Costaridou .......................................................... 541

Breast Component Adaptive Wavelet Enhancement for Soft-Copy Display of Mammograms
Spyros Skiadopoulos, Anna Karahaliou, Filippos Sakellaropoulos, George Panayiotakis, Lena Costaridou .......................................................... 549

Using Wavelet-Based Features to Identify Masses in Dense Breast Parenchyma
Filippou Sakellaropoulos, Spyros Skiadopoulos, Anna Karahaliou, Lena Costaridou, George Panayiotakis .......................................................... 557
## Full-Field Digital Mammography


*Nicholas Petrick, Kyle J. Myers, Sophie Paquerault, Frank W. Samuelson, Brandon D. Gallas, Robert F. Wagner* 

565

Comparison of Computerized Image Analyses for Digitized Screen-Film Mammograms and Full-Field Digital Mammography Images

*Hui Li, Maryellen L. Giger, Yading Yuan, Li Lan, Kenji Suzuki, Andrew Jamieson, Laura Yarusso, Robert M. Nishikawa, Charlene Sennett* 

569

Comparison Between CRT and LCD Displays for Full-Field-Digital-Mammography (FFDM) Interpretation

*Chiara Del Fante, Alexia Bestagno, Viviana Londero, Raffaella Pozzi Mucelli, Valerio Salomoni, Massimo Bazzocchi* 

576

A Harmonized Quality Control Program for Digital Mammography

*Martin Yaffe, Gordon Mawdsley, Aili Bloomquist* 

585

Contrast Threshold of 4 Full Field Digital Mammography Systems Using Different Measurement Methods


593

## Segmentation

The Use of Multi-scale Monogenic Signal on Structure Orientation Identification and Segmentation

*Xiao-Bo Pan, Michael Brady, Ralph Highnam, Jérôme Declerck* 

601

Breast Density Segmentation Using Texture

*Styliani Petroudi, Michael Brady* 

609

Texture Based Mammogram Classification and Segmentation

*Yang Can Gong, Michael Brady, Styliani Petroudi* 

616

Mammographic Risk Assessment Based on Anatomical Linear Structures

*Edward M. Hadley, Erika R.E. Denton, Reyer Zwiggelaar* 

626
Comparison of Methods for Classification of Breast Ductal Branching Patterns

Predrag R. Bakic, Despina Kontos, Vasileios Megalooikonomou,
Mark A. Rosen, Andrew D.A. Maidment .......................... 634

Validation of Graph Theoretic Segmentation of the Pectoral Muscle

Fei Ma, Mariusz Bajger, John P. Slavotinek, Mark J. Bottema ..... 642

Author Index ................................................................. 651