

STUDENT RESEARCH COLLOQUIUM

Daniel Cecil Glas (Mat.Nr. 520832)

International Master Study Programme **Forest
Information Technologies**

Eberswalde University of Sustainable Development
Faculty Forestry and Environment

Scientific Research Project supervisor: Dr. Peter
Rademacher

Module instructor: Prof. Alfred Schultz

Presentation date: 25.04.2013





Terrestrial Laser Scanning of short-rotation plantations for the determination of above-ground biomass

STRUCTURE

1. Terrestrial laser scanning
2. Current inventory practice
3. Methodology
4. Lessons learned
5. Conclusion

.TERRESTRIAL LASER SCANNING





TERRESTRIAL LASER SCANNING

-  Working in most real world environments
-  Standard for 3D modeling of complex scenes
-  Fast, efficient and automatic tool for the determination of basic forest inventory parameters
-  **Methods for** estimating biomass potential of dense **coppice** in a fast and objective way are **currently rare**.

TERRESTRIAL LASER SCANNING

- 🌳 Inventory parameters may include
 - 🌳 Number and position of trees,
 - 🌳 Diameter at breast height (DBH), tree height
 - 🌳 Stem and crown shape parameters
 - 🌳 Taper, sweep, number of branches etc.

CURRENT INVENTORY PRACTICE

-  Manually with sample plot size 40m²
-  Measurement of all shoots at a height of 1 m
-  Merging the diameter with species specific biomass functions
-  Extrapolation to Kg per hectare

.METHODOLOGY

IN A NUTCASE

- 🌱 Scan of SRPs in multiple-scan mode
- 🌱 Stem detection with software (3 in Trial)
- 🌱 *Volume extraction*
- 🌱 *Biomass calculation*
- 🌱 *Comparison of results with ground truthed data*




GLS - 1500




- 🌿 20 Kg (“One-man system”)
- 🌿 360° hor., 70° ver.
- 🌿 500m distance
- 🌿 30.000 points/s
- 🌿 +/- 4mm precision (150m)
- 🌿 Camera



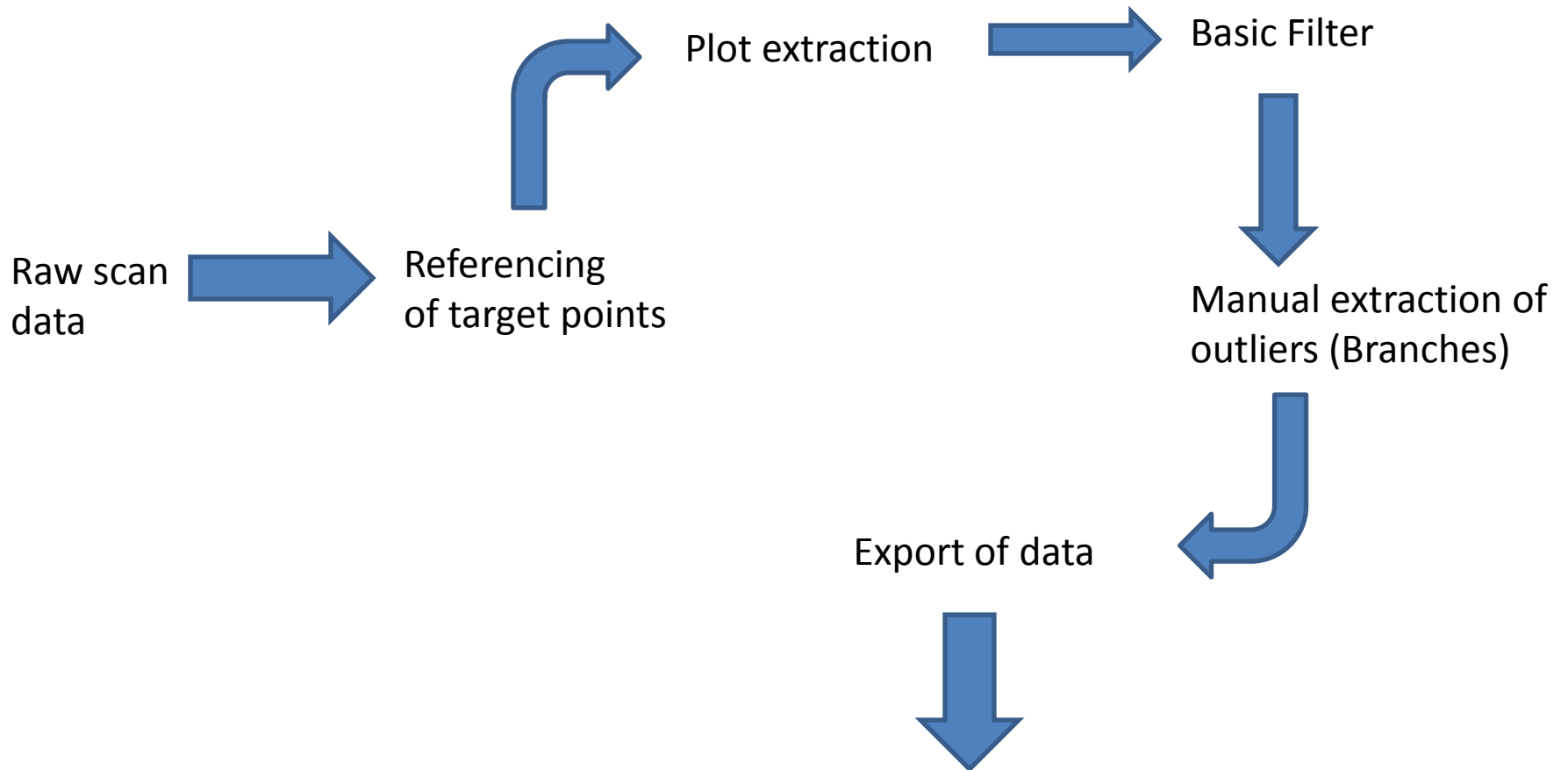
Source: Topcon Corporation

STUDY SITES




-  All located on research fields of the ZIM Agroforst project
 -  Long-term sites
 -  Presence of classic inventory data

-  Wartin, Schönholz, Kummerow, Blumberg
 -  Extremely dense populus spec., and or salix spec. coppice research plots
 -  Max. stem density 14,000 stems per hectare

PRE-PROCESSING IN SCANMASTER SOFTWARE





STEM DETECTION SOFTWARE

-  Inbuilt mesh function of ScanMaster software (TIN)
-  Tscan software from the Warsaw University of Life Sciences
-  Autostem Forest TM from Treemetrics

.RESULTS

RESULTS

-  Acquisition, preparation and pre-processing of data was successful
-  ScanMaster software
 - Inbuilt mesh function not suitable for trees

RESULTS

Autostem Forest TM

 Usually works with bigger plot sizes

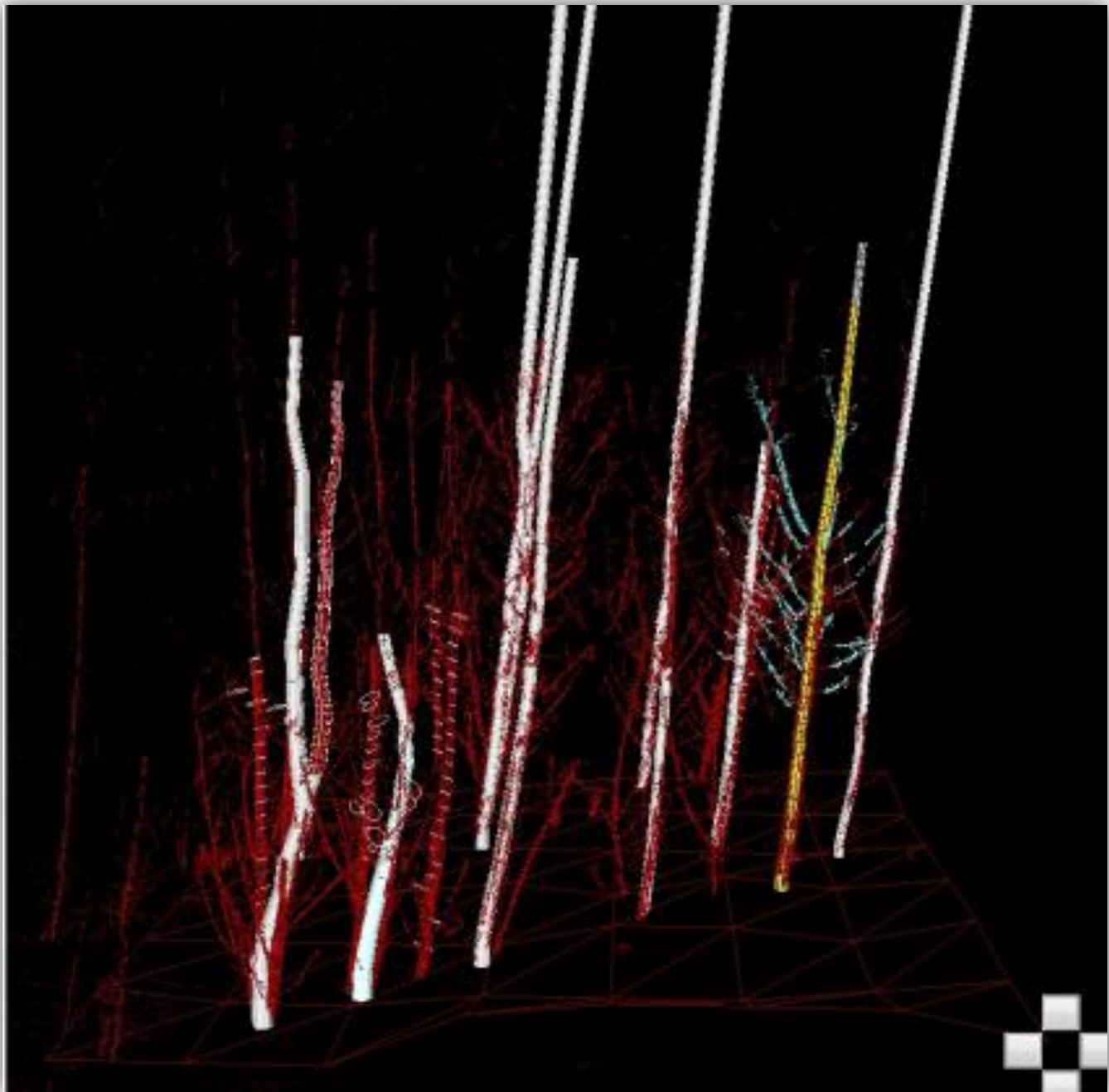
 Real forests

→ Software not able to distinguish objects

Tscan software

 Stems and branches too small for suitable detection

→ No clear classification possible



Object classification with Tscan software

RESULTS

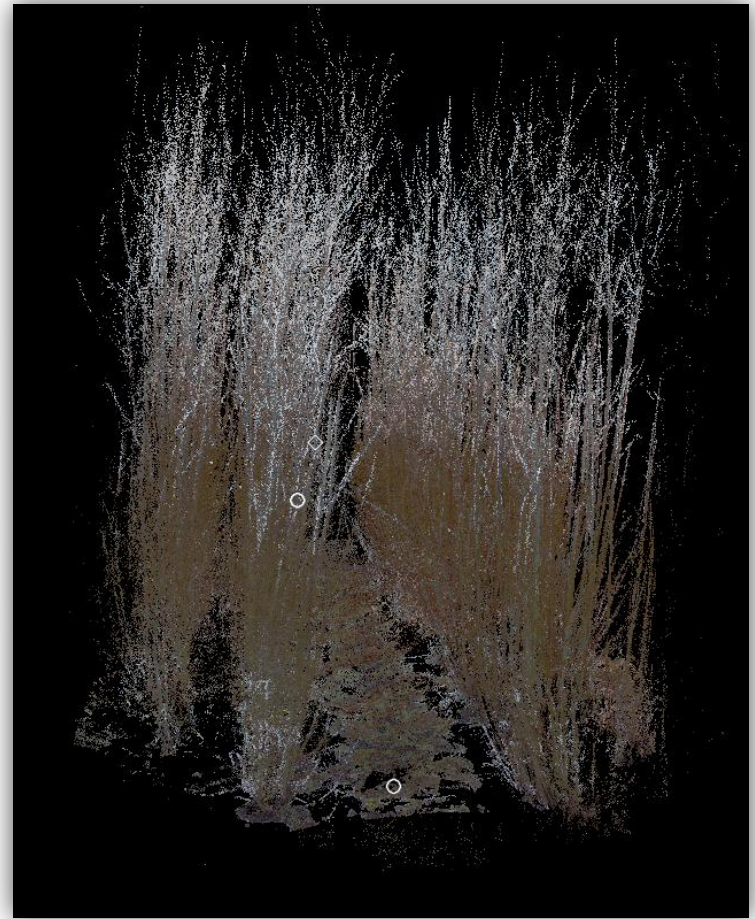
Networking

 ZIM Agroforst, Topcon Europe, WULS, Treemetrics inc.,
HNEE

Guideline for future implementation




FACTORS

- 🌿 Scan mode
- 🌿 Tie points
- 🌿 Wind
- 🌿 Stem recognition
- 🌿 Shadow effect
- 🌿 Edge effect





CONCLUSION.

CONCLUSION

-  Coppice systems build a huge challenge for accurate stem recognition
-  Focus mainly on forest inventory and quality assessments
-  Stem detection software will further develop

CONCLUSION

-  Multiple-scan approach incorporates bias and complicates stem detection
-  Shadow effects must be minimized

ACKNOWLEDGEMENTS

ZIM Agroforst

Dr. Peter Rademacher, Dr. Markus Schmidt, Sören Krämer,
Nora Koim

Topcon inc.

Andreas Hermanowski, Raimo Vollstädt, Veit Kratzenberg,
Andrew Evans

Treemetrics

Cian Mac a´Bháird, James Hurley

Warsaw University of Life Sciences

Krzysztof Sterenczak, Dr. Zajączkowski

LITERATURE CITED

- 1. Seidel, Dominik, et al., et al. The potential of terrestrial laser scanning for the estimation of understory biomass in coppice-with-standards systems. *Biomass & Bioenergy*. 13 November 2012, pp. 20-25.
- 2. Zhao, Kaiguang, Popescu, Sorin and Nelson, Ross. Lidar remote sensing of forest biomass: A scale-invariant estimation approach using airborne lasers. *Remote Sensing and Environment*. 16 September 2008, pp. 182-196.
- 3. Verwijst, Theo und Telenius, Björn. Biomass estimation procedures in short rotation forestry. *Forest Ecology and Management*. 1999, S. 137-146.
- 4. Aschoff, T and Spiecker, H. *ALGORITHMS FOR THE AUTOMATIC DETECTION OF TREES IN LASER SCANNER DATA*. Freiburg : University of Freiburg, 2004.
- 5. Aschoff, T., Thies, M. and Spiecker, H. *DESCRIBING FOREST STANDS USING TERRESTRIAL LASER-SCANNING*. Freiburg : University of Freiburg, 2004.
- 6. *Automatisierte Ableitung von forstlichen Inventurparametern aus terrestrischen Laserscannerdaten*. Aschoff, Tobias, et al., et al. Halle/Saale : Universität Freiburg, 2004. 24. *Wissenschaftlich-Technische Jahrestagung der DGPF*. S. 341-342.

LITERATURE CITED

- 7. Barnea, Shahar and Filin, Sagi. Extraction of Objects from Terrestrial Laser Scans by Integration Geometry Image and Intensity Data with Demonstration on Trees. *Remote Sensing*. 5 January 2012, pp. 88-110.
- 8. Bienert, A., et al., et al. APPLICATION OF TERRESTRIAL LASER SCANNERS FOR THE DETERMINATION OF FOREST INVENTORY PARAMETERS. Dresden, Germany : Technical University of Dresden, 2006. Scientific Research Project –Daniel C. Glas – FIT – Mat.Nr: 520832 pg. 18
- 9. Simonse, Merlijn, et al., et al. AUTOMATIC DETERMINATION OF FOREST INVENTORY PARAMETERS USING TERRESTRIAL LASER SCANNING. Freiburg : University of Freiburg, 2004.
- 10. García, Mariano, et al., et al. Estimating biomass carbon stocks for a Mediterranean forest in central Spain using LiDAR height and intensity data. *Remote Sensing and Environment*. 28 November 2009, pp. 816-830.
- 11. Nordh, Nils-Erik and Verwijst, Theo. Above-ground biomass assessments and first cutting cycle production in willow (*Salix* sp.) coppice - a comparison between destructive and non-destructive methods. *Biomass & Bioenergy*. 24 October 2003, pp. 1-8.

LITERATURE CITED

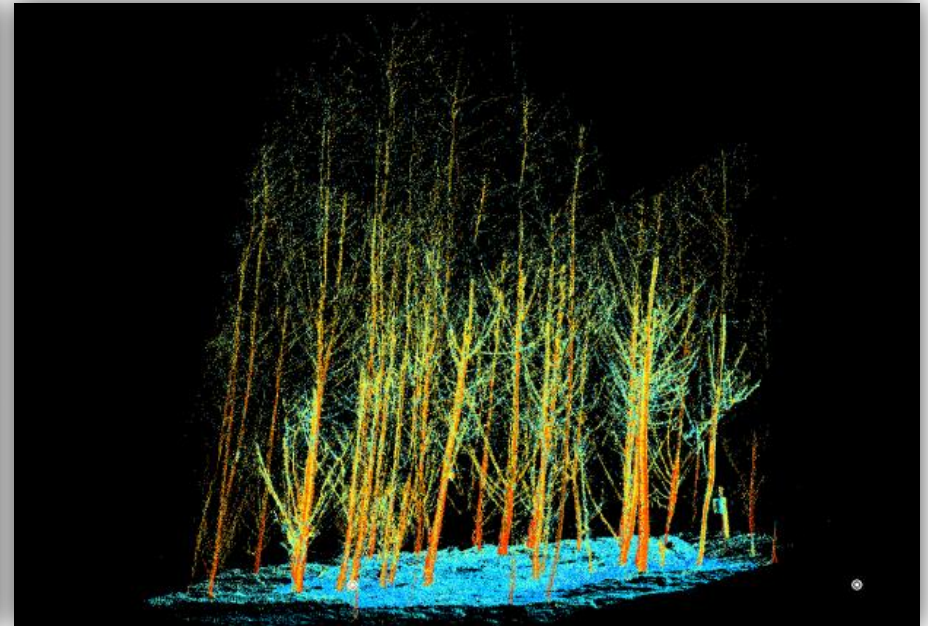
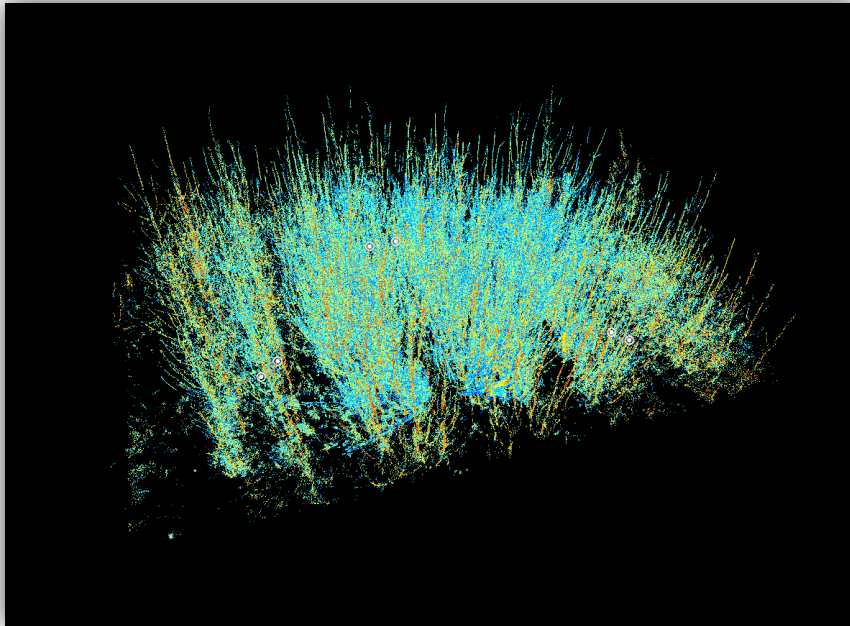
- 12. Murach, Dieter, Knur, Lisa und Schultze, Mareike. *DENDROM - Zukunftsrohstoff Dendromasse. Eberswalde : DENDROM - Koordinationsbüro, 2008.*
- 13. Chmielewski, Leszek J., et al., et al. Fuzzy Hough Transform-Based Methods for Extraction and Measurement of Single Trees in Large-Volume 3D terrestrial LIDAR Data. *ICCVG. 2010, pp. 265-274.*
- 14. Corporation, Topcon. *Leaflet Laserscanner GLS-1500. s.l. : Topcon Corporation, 2012.*
- 15. Stoker, J.M., et al., et al. The new USGS Centre for LiDAR Information Coordination and Knowledge. *Photogrammetric Engineering & Remote Sensing. 2006, S. 613-616.*
- 16. Kaasalainen, S., et al., et al. Radiometric calibration of ALS intensify. *ISPRS Workshop on Laser Scanning 2007 and SilviLaser 2007. 2007, S. 201-205.*
- 17. Kim, Yunsuk, et al., et al. Distinguishing between live and dead standing tree biomass on the North Rim of Grand Canyon National Park, USA using small-footprint lidar data. *remote Sensing and Environment. July 18, 2009, pp. 2499-2510.*
- 18. *REGISTRATION OF TERRESTRIAL LASER SCANNING DATA USING PLANAR PATCHES AND IMAGE DATA. Dold, Christoph und Brenner, Claus. Dresden : Leibnitz University of Hannover, 2006. ISPRS Commision V Symposium `Image Engineering and Vision Metrology`. S. 25-27.*

STUDENT RESEARCH COLLOQUIUM



Thank you for your attention!

POINT CLOUDS



Pre-processed sample scan plots of SRP at Schönholz (left) and Wartin (right)