Mikko Syrjäsuo - Curriculum Vitae

Present Position: Research Associate, U. Calgary, Dept. of Physics and Astronomy

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History: Scientist, Finnish Meteorological Institute, Geophysical Research, 1995-2001

D.Sc. (Technology), Helsinki University of Technology, Helsinki, Finland, 2001

Research Activity

Dr. Syrjäsuo is focusing on **machine vision in auroral research**. This multidisciplinary effort applies contemporary techniques from the fields of pattern recognition, machine learning and machine vision in order to automate the analysis of auroral images. Without these techniques a major part of already existing and future datasets will remain unanalysed.

Before coming to Canada, Dr. Syrjäsuo was first involved in designing space flight instrumentation at the Geophysical Research of the Finnish Meteorological Institute (FMI). The projects included Mars-96, Cassini/Huygens, SWAN (SOHO) and Rosetta cometary mission. Understanding the technical aspects of modern instrumentation was necessary when he later designed and implemented the Finnish auroral all-sky imager (ASI) network. The network — which is part of the MIRACLE network in Fennoscandia — has six imagers operated by FMI and two by collaborating institutes and has been operational since 1996.

Recently Dr. Syrjäsuo has concentrated on developing techniques for analysing auroral images automatically. Due to ambiguities in the interpretation of the auroral content and the specialised application, generally used machine vision solutions are usually not directly applicable. In the first efforts, auroral arcs were searched by using shape skeletons. The algorithm is based on minimum-spanning-tree self-organising maps and is robust even in case of noncontiguous auroral arc appearances. Representing auroral images as attribute trees provided a way to compare images containing arbitrary auroral shapes.

The latest results utilise a dataset consisting of over 300,000 CANOPUS auroral images. Techniques adapted from content-based image retrieval research make it possible to classify images into "arcs", "omega-bands" and "patchy aurora" classes. The actual classification is based on a training set constructed by an auroral image expert. The training set is utilised in *learning* how the human interpretation can be obtained from numerical features representing shapes, texture and auroral brightness.

Representative Publications

Syrjäsuo, M.T., Donovan, E.F. and Peura, M., "Using attribute trees to analyse auroral appearance over Canada", *IEEE Workshop on Applications of Computer Vision*, pp. 289–295, 2002.

Syrjäsuo M.T. and Donovan E.F., "Analysis of auroral images: detection and tracking", *Geophysica*, 38(1–2), pp. 3–14, 2002.

Kauristie K., Syrjäsuo M.T., Amm O., Viljanen A., Pulkkinen T.I., Opgenoorth H.J., "Statistical study of evening sector arcs and electrojets", *Advances in Space Research*, Vol. 28, No. 11, pp. 1605-1610, 2001.

Syrjäsuo M.T., Pulkkinen T.I., "A search engine for auroral forms", *Advances in Space Research*, Vol.28, No. 11, pp. 1611-1616, 2001.

Peura M. and Syrjäsuo M.T., "Flexible heuristic matching of attribute trees", *Proc. 12th Scandinavian Conference on Image Analysis, SCIA-2001*, Bergen, Norway, pp. 207–213, 2001.

Syrjäsuo M.T., Kauristie K., Pulkkinen T.I., "Searching for aurora", *Proc. of the IASTED Int. Conf. on Signal and Image Processing*, Las Vegas, USA, pp. 381–386, 2000.

Syrjäsuo M.T., Pulkkinen T.I., "Determining the Skeletons of the Auroras", *10th Int. Conf. on Image Analysis and Processing, ICIAP'99*, IEEE Computer Society, The Printing House, 1999.

Syrjäsuo M.T, Pulkkinen T.I., Pellinen R.J., Janhunen P., Kauristie K., Viljanen A., Opgenoorth H.J., Karlsson P., Wallman S., Eglitis P., Amm O., Nielsen E., and Thomas C., "Observations of substorm electrodynamics using the MIRACLE network", *Proc. of the Int. Conf. on Substorms-4*, Editors: S. Kokubun and Y. Kamide, Astrophysics and Space Science Library, vol. 238, Terra Scientific Publishing Company/ Kluwer Academic Publishers, pp. 111-114, 1998.

Orsini S., Kauristie K., Massetti S., Cerulli-Irelli P., Candidi M., Syrjäsuo M., Baldetti P., Morbidini A., Sparapani R., Tabacchioni F., "A new all-sky camera — ITACA — is part of the MIRACLE network", *Proc. 5th Int. Conf. on Substorms ICS-5*, St. Petersburg, Russia, 16–20 May 2000.

Syrjäsuo M.T., "FMI All-Sky Camera Network", Finnish Meteorological Institute, Geophysical Publications Nr. 52, ISBN 951-697-543-7, 34 pages, 2001.