Dr. Murat ÜNEY,
Research Fellow
The University of Edinburgh

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Profile

Senior postdoctoral researcher with deep and broad knowledge in signal (time series) and information processing and data fusion applications. Strong research skills developed in both academic and industrial settings. Achievements have included high quality scientific publications addressing application challenges and research transferred into pre-commercialisation level implementations.

Research Interests

Statistical information fusion & sensor signal processing; Multi-object detection and tracking; Approximate Bayesian inference; Variational methods, probabilistic graphical models and message passing algorithms; Point processes (e.g. Random finite sets); Distributed/collaborative processing and optimisation; Monte Carlo methods; Situation awareness and machine perception applications

Research Experience

University of Edinburgh, School of Engineering
Research Fellow **June 2013 - Present**
Multi-sensor fusion, signal & information processing for wide area surveillance

Heriot–Watt University, School of Eng. & Physical Sciences
Research Associate **March 2010 - June 2013**
Distributed data fusion for multi-sensor surveillance

Sabancı University, Signal Processing and Information Systems Lab., İstanbul, Turkey
Graduate Research Assistant **Feb. 2007 - Feb. 2010**
Distributed estimation under communication constraints for sensor networks

Middle East Technical University, Grad. School of Natural & Applied Sciences, Ankara, Turkey
Graduate Research Assistant **Sept. 1999 - Sept. 2002**
Signal processing and telecommunications, digital signal processing (DSP) software

Industrial Experience

Iltaren Advanced Technologies Research Group, Ankara, Turkey
Research and Development Engineer **Jan. 2004 - Feb. 2007**
Modelling and simulation of sensors (ISO 9001 QA)

Software Skills

Prolific in MATLAB and SIMULINK. Distributed/parallel programming with HTCondor. Industrial experience in Object Oriented Programming with C++ under .NET framework. A good command of ANSI C, modular programming, version control tools, Linux, Latex, MS Office.

Education

Middle East Technical University, Ankara, Turkey
Ph.d. *in Electrical and Electronics Engineering* **Sept. 2003 - Aug. 2009**
M.Sc. *in Electrical and Electronics Engineering* (CGPA: 3.93/4.0) **Sept. 1999 - Aug. 2001**

Ankara University, Ankara, Turkey
B.Sc. *in Electronics Engineering* (CGPA: 86/100) **Sept. 1995 - June 1999**

Key Research Achievements & Impact

- A novel approximation framework for solving combinatorially complex estimation problems in multi-sensor multi-object tracking [1, 3, 10, 11, 12, 13, 14]. This framework underpins capabilities such as opportunistic sensor self-localisation in surveillance networks (**UoE**)

- Awarded a UK DSTL Impact Accelerator grant with Cubica Tech. for demonstrating sensor self-localisation algorithms underpinned by the aforementioned framework on a real network of **radars** and **lidars** in security applications (**£30K** of **£100K**)(**UoE**)
- A novel state space model for evaluation of the most efficient statistical detection test with **radar** data cubes in mono-static/bi-static/multi-static radars [2, 8, 9] (**UoE**)
- Proposed higher-order statistics for representing populations of objects in sensor fusion [4]. This concept underpins algorithms for computing the level of confidence of multi-object filters (**UoE**)
- Developed distributed multi-sensor fusion algorithms for fusion of high level of information, i.e., in the population level of abstraction [6, 17, 19]. Attracted follow up grants of **£45K** and **£40K of £100K**, demonstrated these algorithms for sensor fusion in a maritime **radar&camera** sensor suite with BAE Systems and UCL [15](**HWU**)
- Developed distributed estimation/communication strategy optimisation algorithms for sensor networks, and, demonstrated graceful degradation of estimation accuracy with increasing communication cost [5, 7](best runner-up in IEEE student paper competition [22])(**SU/METU**)

Supervision and Teaching

- First supervision of one Ph.D. student on **track-before-detect** for radars [2, 8, 9], co-supervision of one Ph.D. student in object classification in radar images (**UoE**)
- Developed and delivered graduate level tutorials on **optimal and adaptive filtering** of stochastic processes and **multi-sensor multi-target filtering (tracking)** in UDRC Summer Schools (**UoE**)
- Assisted in tutorials for undergraduate level probability theory and graduate level estimation theory and Bayesian filtering classes for engineering students (**HWU**)
- Chairing UDRC research coordination meetings and the reading group (**UoE**)

Professional Activities

- Reviewer for journals IEEE Trans. on Signal Processing, IEEE Signal Processing Letters, IEEE Trans. on Signal and Information Processing in Networks, IEEE Systems, Man, and Cybernetics Part-B, IEEE Trans. on Aerospace and Electronic Systems, Elsevier DSP and Information Fusion
- Served in the technical programme committee (TPC) of International Conference on Information Fusion 2016, 2015, 2014 and 2013, Sensor Signal Processing for Defence (SSPD) 2017–2014, 2011 and 2010, International Conference on Pattern Recognition (ICPR) 2010.
- Member, IEEE Signal Processing Society, International Society of Information Fusion (ISIF).

Participated Projects

D&S IA: Rapid multi-sensor deployment using automatic calibration (UoE) **August - Dec. 2017**

- De facto principal investigator at UoE
- Demonstration of self-calibration algorithms developed in UDRC 2 EWP2 on data from a real fusion network of **radars** and **lidars**, in partnership with the first contractor Cubica Technologies

UDRC 2 EWP2: Distributed multi-sensor processing (UoE) **June 2013 - Present**

- Funded through the UK EPSRC/MOD University Defence Research Collaboration (UDRC) Phase 2 Programme
- Identification of research agenda in multi-sensor processing for situation awareness
- Publishing results in top journals and conferences,
- First supervision of one PhD student, coordination of UDRC researchers
- Development and theoretical analysis of algorithms for i) distributed sensor calibration (e.g., self-localisation) in object tracking networks [1, 3, 10, 11, 14, 13], ii) detection of low SNR/manoeuvring objects [8, 9, 12], iii) Higher-order spatial statistics in fusion [4]

UDRC 1 O02: Distributed target tracking algorithms (HWU) **Apr. 2010 - Feb. 2012**

- Research on solving multi-sensor fusion problems using *Random Finite Set*s with Dr. Daniel Clark (line manager) and Dr. Simon Julier (University College London) [6, 17, 19]

- Funded through the UDRC Phase 1, attracted two follow-up projects: UDRC/DSTL O18 and CDE/DSTL IND1.
- Provided significant contribution to the follow-up proposals (approx. £45K and £40K for HWU)

UDRC 1 O18: Multi-sensor registration for passive sensors (HWU) **March 2012 - July 2012**

- Named RA, random finite set techniques for emitter geo-location with passive sensors [16]

CDE/DSTL IND1: Demonstration of Advanced Distributed Tracking Algorithms (HWU) **Aug. 2012 - April 2013**

- Named RA, demonstrated the algorithms developed in UDRC 1 O02 online on real data in collaboration with BAE Systems and UCL [15].
- Funded by Centre for Defence Enterprise (CDE) through DSTL.
- Implementation of the proposed algorithms in TRL 5-6 (pre-commercialisation level).

Thesis

PhD Thesis: "Decentralized Estimation Under Communication Constraints" addresses estimation with distributed sensor networks using Bayesian team decision theory and Monte Carlo methods
Advisor: Prof. Dr. Kemal LEBLEBİCİOĞLU, METU, EEE Dept.
Co-advisor: Assoc. Prof. Dr. Müjdat ÇETİN , Sabancı University, FENS

M.Sc. Thesis: "Direct and Blind Deconvolution for Multi-Dimensional Signals" generalises a 1-D deconvolution technique to signals with multi-dimensional domains
Advisor: Prof. Dr. Engin TUNCER

Visits, Awards, Achievements

- Erasmus+ funding for visiting Aalto University Sensor Informatics and Biomedical Tech. Lab. directed by Prof. Simo Sarkka (Feb. 2017)
- UDRC funding for visiting University of California at Irvine, Statistical Inference and Learning Lab. led by Dr. Alexander Ihler (Spring 2018)
- Ph.D. research awarded best runner-up award in the IEEE Student paper competition in SIU'09 [22]
- Graduate research scholarship at Sabanci University through the European Commission and the Technological Research Council of Turkey (2007-2010)
- Passed on first attempt Ph.D. Qualification exam for Signal Processing as the major field (pattern recognition as the special interest area) and control systems as the minor field at METU (3^{rd} in THE BRICS & EE Rankings'15)
- Achieved UK First Class Distinction equivalent CGPAs (UCL grading) for graduate courses on statistical, adaptive, multi–resolution signal processing, dynamical systems theory, optimization, information theory, machine vision and pattern recognition during M.Sc.&Ph.d. studies
- Designed and implemented an object oriented MATLAB library for simulating dynamic multiple-object multiple-sensor scenarios, multi-object tracking and various statistical inference algorithms.
- Designed and implemented an ANSI C modem library for the V.32 recommendation of ITU on TI-C54x fixed point Digital Signal Processor (METU) and an ITU T1, T3 codec (BICOM, INC. USA)

Personal Details

- *Citizenship:* Republic of Turkey, UK citizenship expected by Sep. 2017
- *Hobbies:* Music, electric guitar

References

available upon request...

Publications

Journal Publications

[1] Murat Üney, Bernard Mulgrew, Daniel Clark, "Latent parameter estimation in fusion networks using separable likelihoods," *IEEE Transactions on Signal and Information Processing Over Networks*, under review (https://arxiv.org/abs/1708.00842).

[2] Kimin Kim, Murat Üney, Bernard Mulgrew, "Detection via simultaneous trajectory estimation and long time integration," *IEEE Transactions on Aerospace and Electronic Systems*, under review (https://arxiv.org/abs/1709.00310).

[3] Murat Üney, Bernard Mulgrew, Daniel Clark, "A cooperative approach to sensor localisation in distributed fusion networks," *IEEE Transactions on Signal Processing*, vol. 63, no.5, pp. 1187–1199, March 2016.

[4] Emmanuel Delande, Murat Üney, Jeremie Houssineau, Daniel Clark, "Regional variance for multi-object filtering," *IEEE Transactions on Signal Processing*, vol.62, no.13, pp.3415–3428, July 2014.

[5] Murat Üney and Müjdat Çetin, "Optimization of Decentralized Random Field Estimation Networks Under Communication Constraints through Monte Carlo Methods," *Elsevier Digital Signal Processing*, vol.36, pp. 16–28, November 2014.

[6] Murat Üney, Daniel E. Clark, Simon J. Julier, "Distributed Fusion of PHD Filters via Exponential Mixture Densities," *IEEE Journal of Selected Topics in Signal Processing*, vol. 7, no. 3, pp. 521–531, June 2013.

[7] Murat Üney and Müjdat Çetin, "Monte Carlo optimization of decentralized estimation networks over Directed Acyclic Graphs under communication constraints," *IEEE Transactions on Signal Processing*, vol. 59, no. 11, pp. 5558-5576, November 2011.

Conference Publications and Technical Reports

[8] Kimin Kim, Murat Üney, Bernard Mulgrew, "Simultaneous tracking and long time integration for detection in collaborative array radars," IEEE Radar Conf. 2017, Seattle, USA, May 2017.

[9] Kimin Kim, Murat Üney, Bernard Mulgrew, "Detection of manoeuvring low SNR objects in receiver arrays," SSPD 2016, Edinburgh, UK, September 2016.

[10] Murat Üney, Bernard Mulgrew, Daniel Clark, "Distributed localisation of sensors with partially overlapping field-of-views in fusion networks," Fusion 2016, Heidelberg, Germany, July 2016.

[11] Murat Üney, Bernard Mulgrew, Daniel Clark, "Distributed estimation of latent parameters in state space models using separable likelihoods," ICASSP 2016, Shanghai, China, March 2016.

[12] Murat Üney, Bernard Mulgrew, Daniel Clark, "Maximum likelihood signal parameter estimation via track before detect," SSPD 2015, Edinburgh, UK, Sept. 2015.

[13] Murat Üney, Bernard Mulgrew, Daniel Clark, "Cooperative sensor localisation in distributed fusion networks by exploiting non-cooperative targets," IEEE Workshop on Statistical Signal Processing 2014, Gold Coast Australia, 2014.

[14] Murat Üney, Bernard Mulgrew, Daniel Clark, "Target aided online sensor localisation for bearing only clusters," SSPD 2014, Edinburgh UK, Sep. 2014.

[15] J. Barr, Murat Üney, D. E. Clark, D. Miller, M. Porter, A. Gning and S. J. Julier, "A multi-sensor inference and data fusion method for tracking small, manoeuvrable maritime craft in cluttered regions," the Proc. of the 3rd IMA Conference on Mathematics in Defence. IMA, Malvern, UK, October 2013.

[16] Murat Üney, Daniel E. Clark, Simon J. Julier, "Distributed sensor registration based on random finite set representations," *Proc. of the SSPD 2012*. UDRC, London, UK, Sep. 2012.

[17] Murat Üney, Daniel E. Clark, Simon J. Julier, "On the role of information measures in distributed multi–target tracking," *Proc. of the Int. Conf. on Info. Fusion 2011*, July 2011.

[18] Murat Üney and Müjdat Çetin, "Monte Carlo optimization approach for decentralized estimation networks under communication constraints," *Sabancı University Technical Report*, SU FENS 2010/0007, http://research.sabanciuniv.edu/15985, Nov. 2010.

[19] Murat Üney, Simon J. Julier, Daniel E. Clark, Branko Ristić, "Monte Carlo realisation of a distributed multi–object fusion algorithm," in *the Proc. of the SSPD 2010*. UDRC, London, UK, Sep. 2010.

[20] Murat Üney and Müjdat Çetin, "An Efficient Monte Carlo Approach for Optimizing Decentralized Estimation Networks Constrained by Undirected Topologies," in *the Proc. of the Workshop on Statistical Signal Processing (SSP) 2009*. IEEE, Cardiff, Wales, UK, Aug. 2009.

[21] Murat Üney and Müjdat Çetin, "An Efficient Monte Carlo Approach for Optimizing Communication Constrained Decentralized Estimation Networks," in *the Proc. of the* 17^{th} *EUSIPCO*. EURASIP, Glasgow, Scotland, UK, Aug. 2009.

[22] Murat Üney and Müjdat Çetin,"İletişim Kısıtları Altında Dağıtık Rasgele-Alan Kestirimi (Decentralized Random-Field Estimation Under Communication Constraints)," in *the Proc. of the* 17^{th} *Conference on Signal Processing, Communications, and their Applications (SIU 2009)*. IEEE, Antalya, Turkey, April 2009 (best runner-up for the IEEE student paper competition, in Turkish, available through IEEE Xplorer).

[23] Murat Üney and Müjdat Çetin,"Akustik Algılayıcı Ağlarında Çarpan Çizgeleri Kullanarak Hedef Konumlandırma (Target Localization in Acoustic Sensor Networks Using Factor Graphs)," in *the Proc. of the* 16^{th} *Conference on Signal Processing, Communications, and their Applications (SIU 2008)*. IEEE, Aydın, Turkey, April 2008 (in Turkish, available through IEEE Xplorer).

[24] Murat Üney and Müjdat Çetin, "Graphical Model-based Approaches to Target Tracking in Sensor Networks: An Overview of Some Recent Work and Challenges," in *the Proc. of the Int. Symp. on Image and Signal Proc. and Analysis (ISPA 2007)*. IEEE, İstanbul, Turkey, September 2007.

Dissertation and Thesis

[25] Murat Üney, "Decentralized Estimation Under Communication Constraints," *Ph.D. Thesis*, Middle East Technical University, Ankara, August 2009.

[26] Murat Üney, "Direct and Blind Deconvolution for Multi-Dimensional Signals," *M.Sc. Thesis*, Middle East Technical University, Ankara, August 2001.

Other Conferences

[27] Murat Üney and T. Engin Tuncer, "2-D Dizilerin Hatasız Ters-Evrişimi (Exact Deconvolution of 2-D Signals)," in *National Symposium on Signal Processing, Communications and Its Applications (SIU 2002)*, Denizli, Turkey, 2002 (in Turkish).

[28] Murat Üney and T. Engin Tuncer, "Kanal Yankı Giderici için Ters Dönüşümlü Dizilerin Kullanımı (Utilization of Invertible Pseudonoise Sequences for Fast Echo Cancellation)," in *National Symposium on Signal Processing, Communications and Its Applications (SIU 2001)*, Gazi Magusa, 2001 (in Turkish).