

CODATA International Workshop on Motion and Vital Data Acquisition, Storage, and Trends

for Aging Population

25–27 February 2013

Executive Summary

IBM Innovation Center-IBM Israel, Petach-Tikva

The CODATA Workshop was convened in Petach Tikva, in the center of Israel close to Tel Aviv, 25th – 27th February 2013.

In the International Organizing Committee, about 50 experts from 15 countries in five continents came from a wide range of disciplines spanning elderly caregivers, senior citizen representatives to electronics engineers and computer and robotics scientists. About thirty participated, including 15 who came from abroad.

The idea for this CODATA workshop was presented and prepared by workshop Chairman Dr. Reuven Granot, Israel, Secretary of the Israel National CODATA Committee, with support of the International Organizing Committee (Appendix A) that he convened to tackle a gaping need in health management: radically *improving* medical interventions and technologies has naturally increased longevity of unprecedented numbers of the elderly, but to such an extent that the elderly population is growing far faster than the rest of the population. Without focusing on prevention or solving the problems of chronic disease, a crisis is predicted by about 2030 when several countries will reach a ratio of about one working person for each retiree, and in some nations, two retirees per working person. This will not only be an enormous economic burden, but will place a tremendous overload on care giving services, nursing homes, and medical facilities, unless there is pro-active intervention.

The most logical and cost effective approach explored in this CODATA workshop would enable elders to *Age Well* at home (ideally), in retirement communities, or in minimally Assisted Living facilities by incorporating a **telecare solution**, based on intelligent sensing in the elder person's home connected into a real time care giver response.

Research began more than two decades ago to develop such an intelligent "Smart Home" system and in the last years large and small companies all around the world have entered into building this business. Consumer awareness is constantly growing and is expected to drive demand as more elderly and more families and communities press for attainable solutions.

Degenerative diseases of aging are characterized by changes in movement behavior and vital signs. Tele-biometric collection is becoming commonplace, especially for monitoring cardiac patients by medical doctors, but non-parametric measures of behavior change are yet in 'invade' medical consciousness.

Despite this resistance, 'blind' movement sensors and other monitors integrated with computer programs to analyze data collected in near real time are already in use to alert care givers of pattern changes from a normative (personal) baseline which indicate the need for human care giver intervention *before* there is a mishap, usually a fall. Thus these systems are geared to improve care giving by assisting not by replacing human care givers with machines – one common misconception.

Such *in situ* monitoring converts the elder's home into an AAL or Ambient Assisted Living facility and could make the transition to home Assisted Living facility as well, without having to leave home

Extending the grace period before the need to transfer to a nursing home might be necessary, would save millions of dollars while giving peace of mind to family and other care givers, reducing workload with semi-automated manual labor intensive care activities, and eventually identify

trends that make frail elderly feel safe, secure and gently self-empowered, and perhaps even somewhat less lonely.

These ideas are not new. Research and publications during the last two decades have been financially supported in several nations, States, international organizations including the European Commission under the current Framework Programme for research and technological development (FP7), as well as in large corporations in the private sector. Nevertheless, even as the concept has been implemented successfully for up to hundreds of aged in a single facility, the obstacles to scaling-up to monitoring thousands of persons at home, presents a formidable challenge to putting this solution development firmly as a top priority for the tens of millions of affected elderly.

This CODATA Workshop was unlike the typical research conferences. Discussions were not focused on pure science, but on the intersections of electronic engineering, data mining, and systems analysis with care giver concern, geriatrics, and gerontology.

The CODATA workshop was convened to brainstorm, to bring together a wide range of experts, leaders in their areas of expertise, to jointly focus on what would make Ambient Assisted Living (AAL) at home (ideally) or in elder communities common and usual in developed nations around the world. Specifically, how to integrate movement (and other) sensor data with tele-technologies and computer systems to help the elderly to remain well while living independently, securely, and in private at home, in the most cost effective manner.

The workshop was modeled on earlier CODATA Workshops, specifically those in Material Data at Schluchsee in 1984 and Karlsruhe in 1992. Prepared talks were given only on the first day to guide the great variety of participants to focus on obstacles to problem solving.

There was unanimous agreement that this interactive participation was invaluable to help all hone in on and detail the gaps that have thus far,

during the past two decades, kept this field from advancing faster and farther. The program consisted mostly of group discussions, break-out sessions, and consolidation discussions. Great interest was expressed in continuing to collaborate, to bring personal expertise to bear on the problem at hand, rather than to primarily to present one's own tools and/or expertise.

The Workshop was organized as follows:

1. **On the opening day** all participants convened at IBM Israel in Petah Tikva for a series of lectures (see Appendix B). These lectures were meant to build a common language within the multidisciplinary team in order to enable free brainstorming discussions on the next two days.

Following the plenary lecture session, which included a lecture by TK representing an AAL ISERD Consortium, the Workshop participants continue were introduced to Tel Aviv Municipality activities for senior citizens and were hosted in a city tour.

2. **On the second day**, participants divided into four focused Working Groups led by a group Chair (see Appendix A).
3. Working Group 1, Christophe Kunze, chair, led experts now working on hands on experience, supported by geriatric physician, care givers, computer and life scientists and device makers focused on quality of life, QoL, results of data acquisition and analysis in real life situations
4. Working Group 2, Mihoko Otake, chair, led experts in robotics, care givers of elderly and disabled, and technology concentrated on automation and the robotic aspects of acquired process information
 - a. **Working Group 3-4**, Howard Wactlar, chair, led expert computer scientists focused on data mining, analysis. standardization, storage and developing predictive trends indicative of early degeneration of frail elderly that could and prevent mishaps among the monitored

- b. Working Group 5, Gil Siegal, chair, led experts in medical law, practicing gerontologist, and social scientists focused on ethical concerns and privacy issues of monitoring during Smart Home data collection
5. **On the third day and final day**, a closing session of the CODATA Workshop was held at the Dan Panorama Hotel, Tel Aviv, in coordination with Elderlytech, the 1st TK **International Conference on Using Advanced Technologies For Elderly Care: A New Paradigm**, chaired by Yael Benvenisti who served as liaison to the CODATA Workshop. Several lectures were presented by Workshop experts to the 200 Conference registrants.

According to Conference President Prof. Perla Werner, the aim of the Conference was to connect developers and marketers of technologies and key professionals involved in policy making, research and care for the elderly at home, in the community and in institutions; and, to raise awareness and expose the participants to opportunities afforded by technological developments in Israel and abroad.

About half of the CODATA Workshop participants attended and presented their findings to the Conference.

The others convened in a day of round-up sessions chaired by the Workshop Chairman encouraging candid review, interactive discussions, bringing together ideas and suggestions from the previous days' activities.

A short list of Workshop's understandings, conclusions, working recommendations, and future actions:

- One of the CODATA Workshop merits is the personal interaction and open minded atmosphere achieved, which was one of the intended goals. This sense of ease and congeniality among the participants catalyzed recognition of concrete common interests, in particular between experts from different disciplines and nations, who might not meet elsewhere.

- Following this, participants expressed an intention
 - to maintain contact, to create future collaborations and exchange of acquired data and lessons learned; and,
 - to find a means to share longitudinal data across researchers, perhaps by building an online platform.
- Some new and renewed research ideas were suggested, which could best be carried out by cooperating multidisciplinary research groups. For example, a hypothesis was suggested based on the observation that before storms, when barometric pressure drops, more elders fall which may be caused by change in serum potassium, which would induce vertigo, dizziness. Another aspect regarding falls is development of innovative sensors, which seamlessly may realize that the elder person in the apartment is less stable and develops one of known frail elder situation; may be done by analyzing accelerometer data of floor vibrations. In addition to the barometric pressure, the technology that can monitor sleep quality, cognitive state and the cardio/hemodynamic state, which are other potential predictors of falls.
- raining care givers that telecare and technology are meant to aide them, to ease their work, not to spy on them nor to replace them, then they are less likely to cooperate or even sabotage the introduction of new technologies
 - Once integrated, telecare is ideal to cue care givers to do semi-automate labor intensive activities such as calling elder tenants each morning in a CCRC (Continuing Care Retirement Community) or AAL facility, or Naturally Occurring Retirement Communities (NORCs) to assess how they are doing; or, to encourage participation in exercise routines; or to alert care giver to turn bed-ridden patients at specific intervals to reduce the incidence of bedsores.
 - Creating a book of scripts, written texts intended to elicit repeatable answers by elderly that can be scored is ideal both for assessment and for data scoring.

- To practically introduce already existing technologies, it was recommended to start simple and follow 'Lean Startup' including MVP (minimum viable product) techniques.
- To facilitate wider adoption of new technologies, including carrying and use of cell phones, technology that can adapt to personal preferences and not force assisted elderly to change their habits will be most likely to be accepted and used.
- There is a need for standardization of the storage of data acquired into large DB and collect not only daily data, but also include long term changes in elderly behaviour, health situation and death. This is necessary to classify more reliable algorithms for prediction and trends identification.
- Obstacles to use data for trends identification and proactive prevention are due to lack of shared longitudinal data across researchers (standards, protocols, annotation, metadata, semantics, and ownership); event driven or polled; how it was generated and if results are reproducible?
- There are social and legal barriers to medical health data access because of diversity in medical practice.
- Acquired data is usually noisy, partial and unreliable because current instrumentation measures only some aspects and lacks other even more important. Reliability is not insured without use of engineering practices and robotic technologies.
- There are already an impressive number of sensory devices, but more has to be done to enable integration of data and sensor fusion.
- Robotic technologies and not only robots are required to improve reliability of measurements and its analysis based on state space, successful robotic architectures and Agent based software.
- Aging data is of high dimensionality (many variables or features). The right data to extract may not be apparent at the time – advanced processing methods may render new findings in old data.

- There is an ethical imperative to improve the process of innovation, implementation and data acquisition - Inception, R&D, pilot and IRB, marketing, post-marketing.
- In several groups a discussion about who are the stakeholders:
 - Patient/person, his family, his community
 - Care givers – personal, medical and/or care institutions - hospitals, nursing homes, assisted living,
 - Entrepreneurs, products' development, services companies
 - State/government –local, regional, state, supra-state (EU) – health welfare

What is the meaning of Quality of Life? Is it to satisfy the expectations? This may be different for different stakeholders.

- Data protection: What types of information are collected, where stored, who has access, security measures, what happens with the data after one discontinues, how long stored, rights of individuals to access their record/destroy it, justification for different data collection (for the contract).
- Privacy: What types of information can /should be collected, consent to collect; the right to de-activate sensors, commercial use of data for consumer-driven initiatives, etc.
- Monitoring activity is assumed by us as extending the independent living stage. However this is not well defined, since we lack a value measure of monitoring activity and it is not yet possible to compare how monitored data really helps in receiving better and timely medical support. Is monitoring really helping to get physician's attention or the other way around, the physician counts on the system and takes less attention than in the usual situation?
- Difficulties are related to existence of shared data for analysis. The difficulties regard to lack of protocols for acquiring data. Barriers come also from specialists who are skeptic about technologies not well recognized in their fields. Multidisciplinary teams are required to regulate how data acquisition can be automated. Disaster and

emergency situations are not yet covered well by real time analysis of data.

- Several CODATA Working Groups may be suggested:
 - Regulation of Data Acquisition for elderly moving behaviour.
 - Large system integration and activity evaluation.
 - Data formats to enable exchange of data between researchers.
- Future monitoring activity that would focus independently on specific application areas:
 - Peace of Mind
 - Tele-health situation recognition
 - Prediction from acquired data of trends in developing Frail Elderly Situations needing further attention
- When designing research, consider ‘Who needs to be convinced?’ and ‘What would be convincing?’ Different stakeholders have different aim, and not all converge on an elder person who is healthier, less prone to accidents or to emergency intervention, and more satisfied with his circumstances
 - Long term insurance programs and HMOs seek monitoring data that shows lowered costs over time. Proving it with longitudinal monitoring

Long term goals:

- Greater integration with social platform, involving people we like, projects we care about,
- Greater integration of medical care, HMOs, as partners not competitors (financial stake, ego stake) in designing sensors to Smart Homes to include parameters that talk to them
- Greater integration with insurance programs , involve payers to accept, store and distribute monitoring data just as biometric data is shared, in the model of AmericanWell.com

This Executive Summary was prepared by Dr Rae Fishman and Dr. Reuven Granot.

Appendix A

Organizing Committee Participation at CODATA International Workshop on “Motion and Vital Data Acquisition, Storage and Trends Predictive Analysis for Aging Population”.

Chairman	Dr. Reuven Granot
WG1 Chair	Prof. Christophe Kunze
WG2 Chair	Dr. Mihoko Otake
WG3/4 Chair	Prof. Howard Wactlar
WG5 Chair	Prof. Gil Siegal
Conference Chair	Yael Benvenisti
Conference President	Prof Perla Werner

	Australia	A/Prof. Pradeep Ray	Director, Asia-Pacific Ubiquitous , Healthcare research Centre (APuHC), Australian School of Business (ASB), University of New South Wales, Sydney
	Canada	Prof. Victor C.M. Leung	Dept. of Electrical and Computer Engineering, University of British Columbia, Vancouver BC. Canada
		Prof. Geoff Fernie	Vice President, Research at Toronto Rehab Institute, University of Toronto
y		Prof. Jacob Slonim	Canada Foundation for Innovation, Member of Committee of Wise Reviewers; Dalhousie University, Faculty of Computer Science
y	Germany	Dipl.-Ing. Sebastian Chiriac	Embedded Systems and Sensors Engineering (ESS), FZI Forschungszentrum Informatik
		Prof. Thomas Bock	Prof. Prof. h.c./SRSTU, Dr.-Ing. LS fuer Baurealisierung und Baurobotik, TU Muenchen, University of Muenchen
		Ms. Birgid Eberhardt	VDE
		Prof. Dr.-Ing. Ralph Welge	Institut für Verteilte autonome Systeme und Technologien Luneburg
y		Prof. Dr. Ing. Christophe Kunze	Hochschule Furtwangen University (HFU)
		Andreas Braun M.Sc.	Fraunhofer-Institut für Graphische Datenverarbeitung IGD Darmstadt
		Frau Janina Laurila-Epe	DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

y		Dr. Heidrun Mollenkopf	German National Association of Senior Citizens' Organisations (BAGSO), Council of Experts; AGE Platform Europe, Chair of "Universal Accessibility and Independent Living" Expert Group
	Georgia	Prof. Dr. Sci., Ph.D. Paata J. Kervalishvili	Center of Frontier Medical Technologies
	Korea	Dr. Gaetano Ciaravella	Post Doc fellow/ Korea Institute of Science and Technology (KIST) in Seoul, South Korea. In charge of the Joint lab in Biorobotics
	Ireland	Dr. Brian O'Mullane	University City Dublin and CASALA
		Dr. Martin Crane	Dublin City University, Deputy Director at Centre for Scientific Computing & Complex Systems Modeling (SCI-SYM)
y	Japan	Prof. Mihoko Otake	Associate Professor at Chiba University Founding Director, NPO Fonobono Research Institute (FRI)
	UK	Dr Ahmad Lotfi	School of Science and Technology, Nottingham Trent University, UK
	UK/ N Ireland	Dr. Chris D. Nugent	University of Ulster, UK
		Dr. Liming Luke Chen	School of Computing and Mathematics, University of Ulster at Jordanstown
	USA	Charlie Hillman P E	GrandCare Systems LLC
		Dr. Richard Schulz	University Center for Social and Urban Research, Pittsburgh, PA
R		Prof. Ruzena Bajcsy	College of Engineering, Electrical Engineering and Computer Sciences, University of California, Berkeley
		Dr. James McNally	Director of the National Archive of Computerized Data on Aging (NACDA)
		Prof. George Demiris	Director, Clinical Informatics and Patient Centered Technologies School of Nursing & Biomedical and Health Informatics, School of Medicine, University of Washington,
y		Prof. Howard D. Wactlar	School of Computer Science, Carnegie Mellon University; Director, Division of Information and Intelligent Systems, NSF
		Mr. Sholom M. Weiss	IBM T.J. Watson Research Center, Yorktown Heights, NY
		Ms. Pei-Yun (Sabrina) Hsueh	IBM T.J. Watson Research Center, Drive, Hawthorne, NY
		Rev. James McGee	CEO/President, The Oaks, Orangeburg, SC
y		Dr. Debra E. Krotish	Executive Director, SeniorSMART® Center; and University of South Carolina School of Medicine

y		Ms. Stacey M. Pierce, BA, COTA/L, ATP, CAPS, CSA	Director of LIVE@HOME Technologies
		Prof. Misha Pavel	Biomedical Engineering at the Oregon Health Sciences University
		Prof. Robin Felder	Founding Board Member WellAWARE Systems.com and Professor of Pathology, Associate Director Clinical Chemistry at The University of Virginia Health System
		Prof. Diane Cook	Huie-Rogers Chair Professor, School of Electrical Engineering and Computer Science, Washington State University
	Russia	Dr. Galina Lifshits	Institute of Chemical Biology and Fundamental Medicine
	Ukraine	Mr. Alexis Pasichny	Deputy Director, World Data Center for Geoinformatics and Sustainable Development
			Non CODATA Member Countries
y	Austria	Dr. Mario Drobics	Program-Manager Ambient Assisted Living (AAL), Safety & Security Department, Information Management & eHealth, AIT Austrian Institute of Technology GmbH, Viena
		Mr. Thomas Fuxreiter	Health & Environment Department, Biomedical Systems AIT Austrian Institute of Technology GmbH
y	Switzerland	Dr. Katarzyna Wac	University of Geneva, Institute of Services Science and AAL Forum
	Italy	Dr. Emanuela Merelli	University of Camerino Coordinator of the Computer Science Division School of Science and Technology
y		Dr. Stefano Chessa	EvAAL Steering Board Chair, ISTI-CNR and Pisa University
		Dr. Francesco Furfari	Institute of Information Science and Technologies "A. Faedo" (ISTI) National Research Council (CNR), Wireless Networks Laboratory, Pisa
			Host Member Country
y	Israel	Dr. Reuven Granot	Secretary Israel National CODATA Committee, CEO Perlis Ltd, Bar Ilan University
C		Prof Perla Werner	Vice Rector and Head, Center for Research and Study of Aging, University of Haifa Dean, Faculty of Social Welfare and Health Sciences University of Haifa
y		Prof. Yitshal Berner MD MPH	Head, Geriatric Medicine, Meir Medical Center, Affiliated to Tel Aviv University Sackler Medical School

y		Dr. Israel Doron	Department of Gerontology, Faculty of Social Welfare and Health Sciences, University of Haifa
y		Prof. Gil Siegal M.D., LL.B., S.J.D.	Director, Center for Health Law & Bioethics, Faculty of Law, Ono Academic College
y		Mr. Izzy Gal	VP Innovation, Xorcom Ltd
y		Ms. Rotem Gal	BOT, Xorcom Ltd
y		Amit Gefen, Ph.D.	Associate Professor in Biomedical Engineering, Department of Biomedical Engineering, Faculty of Engineering, Tel Aviv University
		Prof. Moshe Leshno	Faculty of Management and Sackler Faculty of Medicine, Tel Aviv University
y		Dr. Ron Maron	Director, Business Development at The Israel-U.S. Binational Industrial Research and Development Foundation
		Gad Mendelson MD	General Manager, Netania Geriatric Center
y		Mr. Nachman Plotinsky	General Manager of The Israeli Center for Development of Accessories for Disabled People, a non-profit association, The Chaim Sheba Medical Center, Tel Hashomer
y		Prof. Shie Manor	Department of Electrical Engineering at the Technion, Israel Institute of Technology
y		Prof. Nathan Intrator	School of Mathematical Sciences, Tel Aviv University, Israel
		Mr. Arie Rotshtein	VP, Mishan – Israel largest Assisted living Chain
y		Dr. Batami Sadan	The Faculty of Social Welfare and Health Sciences, University of Haifa and President at Vaica Medical
C		Prof. Mordechai Shani	Head, The Gertner Institute for Epidemiology and Health Policy Research, The Chaim Sheba Medical Center, Tel Hashomer
y		Mr. Sugarman Dov	Program Manager, Technology and Aging, JDC - ESHEL The Association for the Planning and Development of Services for the Aged in Israel
y		Edith Ohri	Procedureware Ltd, the developer of the GT Data Mining solution
y C		Yael Benbenishti	Department of Gerontology, Faculty of Social Welfare and Health Sciences, University of Haifa
y		Dafna Bar David	General manager, Golden House Tel Aviv
y		Yardena Peres	IBM Research Center, Manager IT for Healthcare & Life Science Haifa, Israel

Y = participated

C = Conference

R = represented Mr Daniel Aranki represented Prof Bajcsy.

Also participated	
Ms. Kathleen Cass - CODATA	Dr Rae Fishman - Israel
Mr. Martin Pladgeman – USA	Ms. Roni Ram - IBM Israel
	Mr. Sivan Yogev - IBM Israel

Appendix B

Program for 25th February 2013

9:45 - 10:20	35 min	<p>Early trends identification of Frailer Elderly situations and the effect of remote monitoring of interventions.</p> <p>Prof. Yitshal BERNER MD MPH, Head of Geriatric Medicine, Meir Medical Center Affiliated to Tel Aviv University Sackler Medical School, 57 Tchernicovski st, Kfar Saba Israel 44281 ynberner@clalit.org.il</p>
10:20- 11:00	40 min	<p>Standardization Issues and Design Methods in Assisted Living: Experiences from german and european activites.</p> <p>Prof. Christophe Kunze Dr. –Ing., Head of the Research Division Embedded Systems and Sensors Engineering, Forschungszentrum Informatik , Haid-und-Neu-Str. 10-14 76131 Karlsruhe chriskunze@gmx.de</p>
11:00-11:30	30 min	Coffee break
11:30- 12:00	30 min	<p>Robots for elder person's use.</p> <p>Assoc. Prof. Mihoko Otake , Research into Artifacts, Center for Engineering, Graduate School of Engineering, The Chiba University, Japan otake@chiba-u.jp</p>
12:00-12:20	20 min	<p>Elder people's aspect</p> <p>Prof. Heidrun Mollenkopf (AGE Platform Europe –several AAL organizations) – German National Association of Senior Citizens' Organizations (BAGSO), Council of Experts; AGE Platform Europe, Chair of “Universal Accessibility and Independent Living” Expert Group</p>
12:20-12:50	30 min	<p>Learning and modeling dynamics from data, and uncertainty and risk in decision making.</p> <p>Assoc. Prof. Shia Manor, Professor of Electrical Engineering, Technion, Israel Institute of Technology, Haifa, Israel shie@ee.technion.ac.il</p>
12:50-13:20	30 min	<p>Motion Behavior monitoring at FZI Research Center for Information Technology</p> <p>Dipl.-Ing. Sebastian Chiriac, Embedded Systems and Sensors Engineering (ESS), FZI Forschungszentrum Informatik, Haid-und-Neu-Str. 10–14, 76131 Karlsruhe, Germany chiriac@fzi.de</p>

13:20-13:40	20 min	Smartphones and elderly. Dr. Katarzyna Wac, University of Geneva, Institute of Services Science, Quality of Life, Group, Geneva, Switzerland Katarzyna.Wac@unige.ch
13:40-14:00	20 min	Risk-assessment and training planning for individualized fall prevention. Dr. Mario Dobrics, Program Manager for Ambient Assisted Living, AIT Austrian Institute of Technology GmbH, AIT Austrian Institute of Technology, Donau-City-Straße 1, 1220 Wien mario.dobrics@ait.ac.at

Appendix C Working Groups

WG2

Dr. Mihoko Otake
Dipl.-Ing. Sebastian Chiriac
Dr. Debra E. Krotish
Dr. Stefano Chessa
Mr. Iossi Dekel
Mr. Sivan Yogev
Ms. Yael Benvenisti
Mr. Nachman Plotnitsky

WG5

Prof Gil Siegal
Prof. Israel Doron
Dr. Heidrun Mollenkopf
Prof. Shani Mordechai
Prof Perla Werner
Ms. Dafna Bar David
Dr. Batami Sadan
Mr. Dov Sugarman

WG1

Prof. Dr. Ing. Christophe Kunze
Rev. James McGee
Ms. Stacey M. Pierce
Dr. Katarzyna Wac
Prof. Yitshal Berner MD MPH
Mr. Izzy Gal
Ms. Rotem Gal
Dr Rae Fishman
Mr. Martin Pladgeman
Ms. Roni Ram

WG3-4

Prof. Howard D. Wactlar
Daniel Aranki for Prof. Bajcsy
Ms. Yardena Peres
Prof. Jacob Slonim
Dr. Mario Dobrics
Dr. Amit Gefen.(on 27th)
Prof. Nathan Intrator (on 26th)
Ms. Edith Ohri