About this issue

This special issue of the BT Technology Journal, a snap-shot of the MIT Media Lab as it prepares to enter its third decade, contains twenty six papers and four overviews written by faculty and students. We hope that these papers give both a feel for our way of working and a view of emerging research themes.

The issue is organised into three thematic sections — Organic Networks, 10×, and 'Other'. (Other is a generic container for emerging themes such as Commonsense Computing, Affective Learning, Simplicity, and Manufacturing Complexity.) The first two themes are related to our increasing understanding of how we as humans think and relate to each other and the world around us. 'Other' is meant as a badge of honour; it is the incubator for emerging trends that cross traditional boundaries.

In their overview Lippman and Pentland describe Organic Networks as scalable, incremental, and contributory networks of people (and machines), co-operating within a global structure towards the aim of sharing local knowledge and decisions. Organic networks are lower cost, more adaptable, and more robust than traditional networks. A central thesis of the collective work on organic networks is that innovation is pushed to the periphery — it will come from users as well as the providers; almost anyone can be a user, and hence an innovator of new services and business opportunities.

The Organic Networks section begins with Lippman and Reed's exploration of the premise that it is possible to make energy- and spectrum-efficient 'viral' radio communications systems that scale (almost) without bound. Bletsas follows with description of a mesh network that combines inspiration from viral radio and perspiration from satisfying the real-world constraints imposed by an island in the Aegean Sea. Paradiso et al scale the communications problem down to meet the needs of 'sensate media', dense sensor networks inspired by biological skin. Bove and Mallet take a decentralised approach to sensing, where local nodes co-ordinate among themselves to maximise their contribution to given goals. Lakshmipathy and Schmandt put distributed communication into the hands of people; their mobile, voice-controlled voice communications system is designed specifically for distributed workgroups. Donath and boyd look at social communication settings, exploring the communal implications of the public display of one's social network. Pentland describes computational models of group interaction dynamics that allow us to answer questions such as: 'Who influences whom and how much?' Norton et al are also interested in the impact of technology on organisational efficiency; they describe two applications, AntiGroupWare and Second Messenger — systems that improve group decision-making. Selker and Goler have interests that extend beyond individuals and organisations to nations — their SAVE system yields secure, reliable, and auditable voting that includes verification of eligibility to vote, authentication, and aggregation of the vote. The final two papers in this section address the obstacles to growth of organic networks. Cavallo argues that a major reason for the lack of change in education is not due to lack of ideas about learning on a micro or individual level, but rather is due to a lack of models for growth and change at a macro or systemic level. Resnick discusses the bias towards centralised theories of mind that act as a 'breaking function' on the spread of organic networks. Both authors present new approaches that facilitate fundamental change at a large scale.

In his overview of 10×, Roy paints a picture of technology augmenting individual human capacity that results in a ten-fold increase in performance. He envisions a continuum of developments from environmental and wearable computing to bionic systems that will enhance our memory, understanding, expressiveness, awareness, and physical performance by an order of magnitude. For both industry and society, 10× has implications ranging from the future of healthcare for an aging population to the future of urban transportation.

The 10× section begins with Vemuri and Bender's description of a 'memory prosthesis' that has short-term utility and long-term promise of expanding our cognitive abilities. O'Modhrain's designs for haptic feedback expand the realm of our physical and environmental interactions by providing the additional frame of reference afforded by touch. Selker examines the efficacy of visually attentive interfaces — interfaces that take into account the autonomic and social responses of our eyes. Blankinship et al turn the world of television on its head in order to diminish the barriers to video storytelling. Davenport et al expand the landscape of creative story potential by collecting media artefacts in a 'fabric' that demands playful, immediate engagement. Machover 'shapes minds musically' by bringing sophisticated participatory musical activities to two problem spaces — education and health. Vercoe also works in the domain of music. His karaoke machine adapts to the pitch and cadence of the singer, offering an unprecedented level of expressive control. The section concludes with Larson et al's description of the Open Source Building, an attempt to embed learning and expressing into our physical work and home environments.

The first of the emerging themes in our third section is 'commonsense computing'. In his upcoming book, *Emotion Machine*, Minsky asks: 'Why don't AIs yet have commonsense?' He goes on to argue that they lack the everyday knowledge all humans possess. This theme is covered by a collection of four papers — Singh et al describe an architecture for building a computer with commonsense; Liu and Singh built tools for utilising this architecture; suites of applications that are enabled or enhanced by an understanding of everyday life are described by Singh et al, and Lieberman et al. Computers with commonsense will be situationally aware and cognisant of goals, having an impact on everything from search engines to robotics. Picard et al define 'affective learning' in terms of new technology, physical systems that sense, model, and respond to affect in learning, that enables new theory, integrating affective and cognitive aspects of thinking, learning, and acting, with the goal to build computer companions with human-like sensibilities that can engage us as learners.

We close the section with two contrasting themes. Manufacturing complexity is Chow and Jacobson's term for building complex devices — things that rival nature in their order of complexity, cheaply. This work takes its inspiration from biological systems; they and their students are using peptides for nanofabrication. They envision molecular assembly lines that will lead to *de novo* biology. These ideas probably have the longest time horizon of any described in this volume, but they promise huge impact. Krikorian and Gershenfeld add a different perspective on complexity in their work on Internet 0. They enable the network to reach further into embedded devices — through the use of an end-to-end modulation scheme. Maeda aims to balance complexity with simplicity — building systems that provide the right levels of abstraction to their users, that do what they say clearly and flexibly. Simplicity is an issue for any industry that directly touches people, everything from publishing, to consumer electronics, to financial services. Finally, Ishii et al bring the worlds of complexity and simplicity together in their tangible interface to volumetric data.

Walter Bender

Media Lab Executive Director and Senior Research Scientist

Steve Whittaker

Principal Consultant, BT Strategic Research Centre