

Assistive technology: at the crossroads of the health sciences and engineering

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Introduction

The term assistive technology or adaptive technology (AT) refers to technological solutions to help the elderly or people with disabilities. AT makes use of assistive, adaptive, and rehabilitative devices. The American 1998 amendment to Section 508 of the Rehabilitation Act defines assistive technology as (Section 508):

Any item, piece of equipment, or system, whether acquired commercially, modified, or customized, that is commonly used to increase, maintain, or improve functional capabilities of individuals with disabilities.

Some of these devices are well-known and are, in some form or other, already in use for centuries. Examples of these are hearing aids (starting from ear trumpets or ear horns, already known in the 17th century), and spectacles (modern eyeglasses are probably invented in the 13th century (Glasses)), while others are quite new, such as devices to help manipulate mobile phones. The invention of the Braille system, besides being the first digital form of writing, can be considered as a 19th century form of assistive technology. It should be observed that modern technology, such as the computer, is not only a help but often also a source of new problems, needing its own AT-modifications.

Informetric data

In this section we provide standard informetric data related to AT, describing the most active countries and institutes, the

most used sources for publication in this field, the most-cited article and a description of its growth. Data were collected on February 8, 2011 from Thomson Reuters' Web of Science.

The following search string for a topic search was used: ((TS=assistive OR TS=rehabilitative) AND (TS=technol*)) OR (TS="adaptive technology"). This yielded 2209 retrieved items, which – as far as we checked – seem all to be on topic. We first tried by adding TS=adaptive to the two other topic searches, but this resulted in many false positives. This is the reason why (TS="adaptive technology"), is a separate search element.

In terms of publishing and citation activities AT clearly is a small scientific area. The topic h-index (Banks, 2006) of these 2209 retrieved items is 35. Searching for the most-cited article we found:

Computer assisted orthopaedic surgery – image guided and robotic assistive technologies, written by A.M. DiGioia, B. Jaramaz and B.D. Colgan, a team from Pittsburgh (PA, USA). Published in the journal Clinical Orthopaedics and Related Research, Issue 354, pages 8-16, September 1998; cited 217 times.

The relatively low number of citations of the most-cited article in AT (Hirsch' article introducing the h-index has already 678 citations) is another proof of the fact that the field is – in terms of academic publications – still in its infancy. Yet, it is also a growing field as shown in Figure 1. The growth of the number of publications

in the Thomson Reuters database can best be described by a power law:

Number of publications = $2.133 (\text{Year})^{1.573}$
 where 1990 is year 1 ($R^2 = 0.93$), see Figure 1.

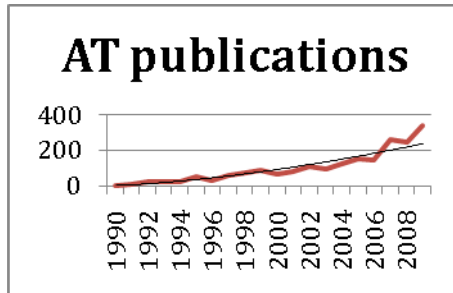


Figure 1. Growth of AT publications

Almost half (48.8%) of these publications are contributions to conference proceedings (characteristic for an engineering related field), while 42.1% are regular articles; 3.7% are reviews. Publications in AT are spread over many JCR subject areas. The top 10 is shown in Table 1. This list is topped by *Rehabilitation*, but otherwise dominated by computer science categories. Note that *Education Special* is 7th. Information and Library Science is 21st with 45 publications.

Most active countries and institutes in AT. The USA leads by far, followed by the United Kingdom. Belgium is 24th, with 15 publications (5 of which are from K.U.Leuven) in the Thomson Reuters list while China, which is often among the top scientific producers, is (only) 14th. Leading institutes in terms of publications are mainly situated in the USA and Canada, with the University of Pittsburgh being the most productive one.

Table 1. (JCR) Subject areas for the field of assistive technology

Subject Area	Number of publications
Rehabilitation	970
Computer science, theory & methods	256
Engineering, biomedical	159
Computer science, information systems	147

Engineering, electrical & electronic	144
Computer science, artificial intelligence	142
Education, special	111
Computer science, interdisciplinary applications	93
Computer science, cybernetics	90
Robotics	79

Table 2. Top 10 most active countries

Country or region	Number of publications
USA	936
England	207
Canada	174
Italy	120
Netherlands	77
Germany	68
Japan	59
Sweden	59
Australia	52
France	49

The list of most used sources for publications in AT (Table 3) is headed by *Assistive Technology Research Series*, which is not a journal but a book series from IOS Press (main offices in Amsterdam) which started in 1995. Also the second one in this list is a book series, namely *Lectures Notes in Computer Science* (Springer). Number three, *Assistive Technology*, is an American journal (publishing two issues a year) with a 2009 2-year impact factor of 0.659, and a 5-year impact factor of 1.299. It is the official journal of RESNA, Rehabilitation Engineering and Assistive Technology Society of North America, an American professional organization. In 2009 it ranked 35th (of 53) in its subject area.

The list of most-used title words (Table 4) gives a clear idea of the topics studied in the field. Besides the ones in this list we also note word stems such as visual (82 times), support (74 times) health (68 times), improv (56 times), stroke (37 times) and tongue (11 times).

Table 3. Most used sources for publications in AT

Sources	Number of publications
Assistive Technology Research Series	330
Lecture Notes in Computer Science	163
Assistive Technology	83
Assistive Technology from Adapted Equipment to Inclusive Environments	64
Disability and Rehabilitation	63
Challenges for Assistive Technology	61

Table 4. Most-used title words

Word stem	Number of uses	Word stem	Number of uses
technolog	869	person	146
assistive	750	adaptive	140
use + using	464	comput	123
disab	283	home	114
people	217	wheel	103
stud	191	old	102
rehabilit	163	mobil	96
age + aging	159	robot	93

Conclusion

AT is by far not a hot field. Yet, it is a growing field with high social relevance. AT, situated on the crossroads of the health sciences and technology is an applied field and as far as we see with little direct theoretical underpinning. For colleagues active in this field obtaining useful results is more important than publishing many articles. Our home institute, KHBO, wishes to become a regional leader in this field, not only by delivering many useful tools in collaboration with the economic actors in the region but also by publishing the methods leading to these practical results. By publishing this contribution we hope to attract more attention to this small but interesting research area.

References

Banks, M.G. (2006). An extension of the Hirsch index: indexing scientific topics and

compounds. *Scientometrics*, 69(1), 161-168.

Glasses. <http://en.wikipedia.org/wiki/Glasses> (visited on February 14, 2011)

Section 508. <http://www.section508.gov/>