



US008009772B1

(12) **United States Patent**
Ormsher et al.

(10) **Patent No.:** **US 8,009,772 B1**
(45) **Date of Patent:** **Aug. 30, 2011**

(54) **CONCURRENT SIGNAL COMBINING AND CHANNEL ESTIMATION IN DIGITAL COMMUNICATIONS**

6,985,515 B2 1/2006 Mesecher
2002/0193146 A1* 12/2002 Wallace et al. 455/562
2005/0018793 A1* 1/2005 Learned 375/340

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 641 days.

(21) Appl. No.: **11/564,396**

(22) Filed: **Nov. 29, 2006**

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/982,134, filed on Nov. 4, 2004.

(51) **Int. Cl.**
H04L 27/06 (2006.01)

(52) **U.S. Cl.** **375/341; 714/795**

(58) **Field of Classification Search** **375/262, 375/265, 267, 340, 341, 347; 714/794, 795**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,697,441 B1 2/2004 Bottomley
6,721,366 B1* 4/2004 Van Stralen 375/262
6,934,317 B1 8/2005 Dent
6,983,008 B2 1/2006 Mesecher

OTHER PUBLICATIONS

S. M. Alamouti, "A Simple Transmit Diversity Technique for Wireless Communications," IEEE Journal on Selected Areas in Communications, vol. 16, pp. 1451-1458, Oct. 1998.
Joachim Hagenauer, Elke Offer, and Lutz Papke, "Iterative Decoding of Binary Block and Convolutional Codes," IEEE Transactions on Information Theory, vol. 42, No. 2, pp. 429-445, Mar. 1996.
Jan Bajcsy, et al, "On Iterative Decoding in Some Existing Systems," IEEE Journal on Selected Areas in Communications, vol. 19, No. 5, May 2001.
Rick S. Blum, et al, "Improved Space-Time Coding for MIMO-OFDM Wireless Communications," IEEE Transactions on Communications, vol. 49, No. 11, pp. 1873-1878, Nov. 2001.
L. Hanzo, T. H. Liew, and B. L. Yeap, *Turbo Coding, Turbo Equalization and Space-Time Coding for Transmission over Fading Channels*, IEEE Press, pp. 395-398, 2002.
Ormsher and Mason, "A New Turbo Decoding Algorithm with Joint Time and Phase Estimation", IEEE Military Communications Conference, 2004.

* cited by examiner

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(57) **ABSTRACT**

In the reception of digital information transmitted on a communication channel, a characteristic exhibited by the communication channel during transmission of the digital information is estimated based on a communication signal that represents the digital information and has been received via the communication channel. Concurrently with the estimating, the communication signal is used to decide what digital information was transmitted.

11 Claims, 16 Drawing Sheets

