

# Neural Network Based Brain Tumor Detection Using MRI

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**Abstract:** - Medical Image fusion plays an important role in medical field to diagnose the brain tumors which may be classified as benign or malignant. CNN is employed to fuse two brain MRI images with different vision. The fused image is going to be more informative than the source images. The feature and wavelet features are extracted from the fused image. The CNN Classifier, classifies the brain tumors supported trained and tested features. The proposed method achieved 92.48% sensitivity, 99.9% specificity and 99.69% accuracy. Experimental results obtained from fusion process prove that the utilization of the proposed image fusion approach shows better performance while compared with conventional fusion methodologies.

**Key Words:**— MRI Images, Tumors, CNN Classifier.

## I. INTRODUCTION

Medical image processing has developed together of the critical factors in regular clinical applications, like disease diagnosis and treatment planning. due to the technical limitations, the standard of medical images is typically unsatisfactory, degrading the accuracy of human interpretation and further medical image analysis, thereby, requiring the standard of those images to be enhanced. One approach to reinforce the image quality is by image denoising. Several denoising approaches, like adaptive filters, wavelet-based methods, etc. were proposed. Another efficient technique is by image fusion which improves the image quality by combining the corresponding information from multimodal images into one fused image. This resulting image is named as fused image.

A fusion process is nothing but a mixture of salient information so as to synthesize a picture with more information than individual image. Image fusion may be a process of mixing multiple input images of an equivalent scene into one fused image, which preserves full content information and also retaining the important features from each of the first images. The fused image should have more useful information content compared to the individual image. Radiologists mostly prefer both MR and CT images side by side, when both images are available. This provides all of them the available image information, but its accessibility is restricted to visual correlation between the 2 images.

Both CT and MR images are often employed because it is difficult to work out whether narrowing of a vertebral canal is caused by a tissue or bone. Both the CT and MR modalities provide complementary information. so as to properly visualize the related bone and soft tissue structures, the pictures must be mentally aligned and fused together. This process results in more accurate data interpretation and

utility. In fundamental multi-modal image fusion methodologies, the source image is simply overlaid by assigning them to different colour channels. In colour image fusion, this overlay approach is employed to expand the quantity of data over one image, but it doesn't affect the image contrast or distinguish the image features.

## II. LITERATURE SURVEY

Title: brain tumour classification using deep CNN features via transfer learning

Author: Deepak P. and M. Ameer (2019)

Brain tumor classification is a crucial problem in computer-aided diagnosis (CAD) for medical applications. The proposed arrangement adopts the concept of deep transfer learning and uses a pre-trained Google Net to extract features from brain MRI images. The experiment follows a patient-level five-fold cross-validation process, on MRI dataset from fig share. The proposed system records a mean classification accuracy and outperforming all state-of-the-art methods. Other performance measures utilized in the study are the world under the curve (AUC), precision, recall, F-score and specificity. additionally, the paper addresses a practical aspect by evaluating the system with fewer training samples. The observations of the study imply that transfer learning may be a useful technique when the supply of medical images is restricted.

Multi-Classification of brain tumour Images Using Deep Neural Network

Author: Hossam H. Sultan et al. (2019)

Brain tumor classification may be a crucial task to gauge the tumors and make a treatment decision consistent with their classes. There are many imaging techniques wont to detect brain tumors. However, MRI is usually used thanks to its

superior image quality and therefore the fact of counting on no radiation. Deep learning (DL) may be a subfield of machine learning and recently showed an interesting performance, especially in classification and segmentation problems. during this paper, a DL model supported a convolutional neural network is proposed to classify different brain tumour types using two publicly available datasets. the previous one classifies tumors into (meningioma, glioma, and pituitary tumor). the opposite one differentiates between the three glioma grades (Grade II, Grade III, and Grade IV). The datasets include 233 and 73 patients with a complete of 3064 and 516 images on T1-weighted contrast-enhanced images for the primary and second datasets, respectively. The proposed network structure achieves a big performance with the simplest overall accuracy respectively, for the 2 studies. The results indicate the power of the model for brain tumour multi-classification purposes.

Deep learning-based brain tumour classification and detection system

Author: Ali Ari and Davut Hanbay(2018)For this reason, using an automatic tumor detection system is extremely important to assist radiologists and physicians to detect brain tumors. At first, non-local means and native smoothing methods were to erase occurred noises. At the Stage two cranial resonance (MR) images were classified as benign or malignant by using ELM-LRF. At the third stage, the tumors were segmented. within the experimental studies the classification accuracy of cranial MR images is 97.18%. Evaluated results showed that the proposed method's performance was better than the opposite recent studies within the literature.

#### A. Proposed Work

This paper we propose a completely unique region based image fusion algorithm for multifocus and multimodal images which also overcomes the restrictions of various approaches.

- In our proposed system, Medical image fusion combines different modality of medical images to supply a top quality fused image with spatial and spectral information. The fused image with more information improved the performance of image analysis algorithms utilized in different diagnosis applications.
- The brain tumour region is segmented using the extracted features and CNN classifier helps to spot whether the tumor is benign or malignant. Thus it helps the physician and radiologist for brain tumour diagnosis for human surgery. The brain tumors, are the foremost common and aggressive disease,

resulting in a really short anticipation in their highest grade.

- Thus, treatment planning may be a key stage to enhance the standard of lifetime of patients. computed tomography (CT), resonance Imaging (MRI)and ultrasound image are used to detect the tumor during a brain, lung, liver, prostate, etc. Especially, during this work MRI images are wont to diagnose tumor within the brain. However, the large amount of knowledge generated by MRI scan thwarts manual classification of tumor vs non-tumor during a particular time.
- Hence trusted and automatic classification scheme are essential to stop the death rate of human.
- The automated brain tumour classification is extremely challenging task in large spatial and structural variability of surrounding region of brain tumour. during this work, automatic brain tumour detection is proposed by using Convolutional Neural Networks (CNN) classification.
- The load of the neuron is given as small.

#### B. Advantages:

- Performance metrics is improved as compared to the prevailing system.
- High accuracy is obtained.
- Precision and recall is increased.

Mass screening retinal pictures may have different picture resolution, illumination, and contrast. Standardizing these variables enables to encourage the process of profound learning. The picture preprocessing is applied here as follows. First, all retinal images are resized to the same field of view (FOV) radius size. We set this radius size  $r=384$  pixels to get an image size close to that used in. A technique for illumination equalization and improvement of contrast is then used.

### III. BLOCK DIAGRAM

#### A. Gaussian Filtering

The idea of Gaussian smoothing is to use this 2-D distribution as a 'point-spread' function, and this is often achieved by convolution. Since the image is stored as a set of discrete pixels we'd like to supply a discrete approximation to the Gaussian function before we will perform the convolution. Then we will truncate the kernel at now. It is not obvious the way to pick the values of the mask to approximate a Gaussian.

We integrated the value of the Gaussian over the whole pixel. The integrals are not integers: we rescaled the array so that the corners had the value 1. Finally, the 273 is that the sum of all the values within the mask.

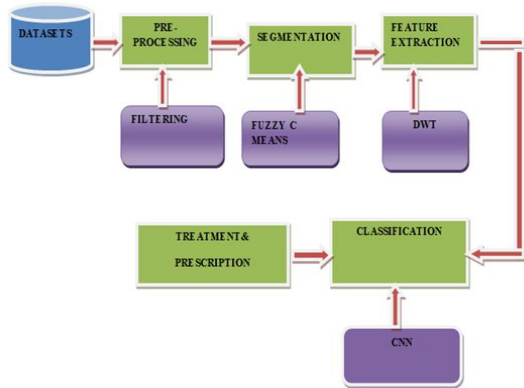


Fig.1. Block Diagram

Thus the 2-D convolution are often performed by first convolving with a 1-D Gaussian within the x direction, then convolving with another 1-dimensional Gaussian within the y direction.

### B. Segmentation

Segmentation partitions a picture with comparable characteristics into different areas comprising each pixel. The areas should be heavily related to depicted objects or characteristics of interest in order to be relevant and helpful for picture assessment and interpretation. Significant segmentation is the first step from low-level picture processing to transform a gray or color picture into one or more other pictures into a high-level picture description of characteristics, items, and scenes. Successful image analysis relies on segmentation reliability, but precise picture partitioning is usually a very difficult issue.

FUZZY C-MEANS (FCM) clustering algorithm permits a knowledge to belong to quite two clusters. This method is usually utilized in change detection, pattern recognition and classification. It is mainly aimed to attenuate the target function as defined within the Equation.

The FCM program applies to a broad range of issues in the assessment of geostatistical information. For any set of numerical data, this program produces fuzzy partitions and prototypes. These partitions are helpful to support recognized substructures or to suggest substructure in unexplored information. A generalized minimum-square objective function is the clustering criterion used to aggregate subsets.

### C. Feature Extraction

Feature extraction methods encompass, besides the normal transformed and non-transformed signal characteristics and texture, structural and graph descriptors.

DWT: In numerical analysis and functional analysis, a discrete wavelet transform (DWT) is any wavelet transform that the wavelets are discretely sampled.

### D. Classification

As a rule, the classifying person also locates specific training sites on the image to spot the classes. For each class thus outlined, mean values and variances of each band went to classify them are calculated from all the pixels enclosed in each site. More than one polygon is typically drawn for any class. The classification program then acts to classify the info representing each class. When the classification for a category is plotted as a function of the band the result's a spectral signature or spectral response curve for that class. The multiple spectral signatures so obtained are for all of the materials within the location that interact with the incoming radiation.

*Convolution neural network(CNN):*

A multilayer NN model, inspired by the neurobiology of visual cortex, that consists of convolutional layer(s) followed by fully connected layer(s). In between these two types of layers, there may exist sub-sampling steps. They get the higher of DNNs, which have difficulty in scaling well with multidimensional locally correlated input file. Therefore, the main application of the CNN has been in data sets, where the number of nodes and parameters required to be trained is relatively large (e.g., image analysis). Exploiting the "stationary" property of an image, convolution filters (CFs) can learn data-driven kernels. Applying such a CF along with a suitable pooling function reduces the features that are supplied to the fully connected network to classify. However, in case of large data sets, even this can be daunting and can be solved using sparsely connected networks.

### E. GLCM

Creating a GLCM, then extracting statistical measures from this matrix.

## IV. INPUT DESIGN

The input design is that the link between the knowledge system and therefore the user. It comprises the developing specification and procedures for data preparation and people steps are necessary to place transaction data in to a usable form for processing are often achieved by inspecting the pc to read data from a written or printed document or it can occur by having people keying the info directly into the system. the planning of input focuses on controlling the quantity of input

required, controlling the errors, avoiding delay, avoiding extra steps and keeping the method simple.

The input is meant in such how in order that it provides security and simple use with retaining the privacy. Input Design considered the subsequent things:

- What data should tend as input?
- How the info should be arranged or coded?

#### A. Objectives

1. Input Design is that the process of converting a user-oriented description of the input into a computer-based system.
2. It's achieved by creating user-friendly screens for the info entry to handle large volume of knowledge. The goal of designing input is to form data entry easier and to be free from errors. the info entry screen is meant in such how that each one the info manipulates are often performed. It also provides record viewing facilities.
3. When the info is entered it'll check for its validity. Data are often entered with the assistance of screens. Appropriate messages are provided as when needed in order that the user won't be in maize of instant. Thus the target of input design is to make an input layout that's easy to follow.

### V. OUTPUT DESIGN

A quality output is one, which meets the wants of the top user and presents the knowledge clearly. In output design it's determined how the knowledge is to be displaced for immediate need and also the text output. it's the foremost important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to assist user decision-making.

1. When analysis design computer output, they ought to Identify the precise output that's needed to satisfy the wants.
2. Select methods for presenting information.
3. The output sort of a data system should accomplish one or more of the subsequent objectives.
  - Signal important events, opportunities, problems, or warnings.
  - Trigger an action.
  - Confirm an action.

### VI. SYSTEM REQUIREMENTS

*General:*

The system requirement of the project is described and therefore the specification of the software and hardware requirements of the project is described.

#### A. Hardware Requirements

- Processor Type: Pentium -IV
- Speed: 2.4 GHZ
- Ram: 128 MB RAM
- \* hard disc: 20 GB HD

#### B. SOFTWARE REQUIREMENTS:

- OS: Windows 7
- Software Programming Package: MATLAB R2018a

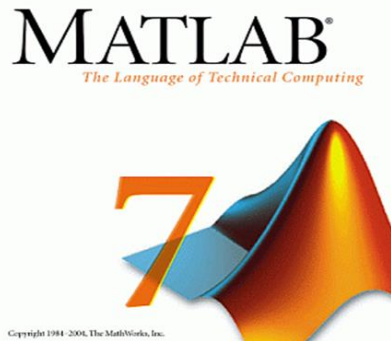
### VII. SOFTWARE DESCRIPTION

MATLAB® is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar notation. Typical uses include:

- Math and computation
- Algorithm development
- Modelling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including graphical user interface building.

MATLAB is an interactive system whose basic data element is an array that doesn't require dimensioning.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to supply quick access to matrix software developed by the LINPACK and EISPACK projects. In university environments, it's the quality instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is that the tool of choice for high-productivity research, development, and analysis.



Very important to most users of MATLAB, toolboxes allow you to find out and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that reach the MATLAB environment to unravel particular classes of problems. Areas during which toolboxes are available include signal processing, control systems, neural networks, symbolic logic, wavelets, simulation, and lots of others.

The MATLAB system consists of five main parts:

1. Development Environment. This is the set of tools and facilities that assist you use MATLAB functions and files. Many of these tools are graphical user interfaces. It includes the MATLAB desktop and Command Window, a command history, and browsers for viewing help, the workspace, files, and therefore the search path.
2. The MATLAB Mathematical Function Library. It allows both "programming within the small" to rapidly create quick and dirty throw-away programs, and "programming within the large" to form complete large and complicated application programs.
3. Handle Graphics®. This is the MATLAB graphics system. It also includes low-level commands that allow you to completely customize the looks of graphics also on build complete graphical user interfaces on your MATLAB applications.
4. The MATLAB Application Program Interface (API). This is a library that permits you to write down C and FORTRAN programs that interact with MATLAB.

## VIII. DEVELOPMENT ENVIRONMENT

### A. Introduction

This chapter provides a quick introduction to starting and quitting MATLAB, and therefore the tools and functions that assist you to figure with MATLAB variables and files. For more information about the topics covered here, see the corresponding topics under Development Environment within the MATLAB documentation, which is out there online also as in print.

*Starting and Quitting MATLAB:*

### B. Starting MATLAB

On a Microsoft Windows platform, to start out MATLAB, double-click the MATLAB shortcut icon on your Windows desktop.

On a UNIX platform, to start out MATLAB, type matlab at the OS prompt.

### C. Quitting MATLAB

To end your MATLAB session, select Exit MATLAB from the File menu within the desktop, or type quit within the Command Window. To execute specified functions whenever MATLAB quits, like saving the workspace, you'll create and run a finish.m script.

### D. MATLAB Desktop

The first time MATLAB starts, the desktop appears as shown within the following illustration, although your Launch Pad may contain different entries.

You can change the way your desktop looks by opening, closing, moving, and resizing the tools in it. All the desktop tools provide common features like context menus and keyboard shortcuts. For example, you'll specify the font characteristics for Command Window text. For more information, click the Help button in the Preferences dialog box.

### E. Desktop Tools.

You can also use MATLAB functions to perform most of the features found within the desktop tools. The tools are:

- Current Directory Browser
- Workspace Browser
- Array Editor
- Editor/Debugger
- Command Window
- Command History
- Launch Pad
- Help Browser

### F. Command Window and Command History

Lines you enter within the Command Window are logged within the Command History window. In the Command History, you'll view previously used functions, and replica and execute selected lines. The exclamation point character! is a shell escape and indicates that the remainder of the input line may be a command to the OS. When you quit the external program, the OS returns control to MATLAB.

### G. Launch Pad

MATLAB's Launch Pad provides quick access to tools, demos, and documentation.

### H. Help Browser

Use the assistance browser to look and consider documentation for all of your Math Works products. The Help browser may be a browser integrated into the MATLAB desktop that displays HTML documents.

To open the assistance browser, click the assistance button within the toolbar, or type help browser within the Command Window. The Help browser consists of two panes, the assistance Navigator, which you employ to seek out information, and therefore the display pane, where you view the knowledge.

#### I. Help Navigator

Use to Help Navigator to find information. It includes

1. Display Pane: After finding documentation using the assistance Navigator, view it within the display pane. While viewing the documentation, you can:
2. Bookmark pages - Click the Add to Favourites button in the toolbar.
3. Print pages - Click the print button within the toolbar. Find a term within the page - A term within the Find in page field within the toolbar and click on Go.
4. Other features available within the display pane are: copying information, evaluating a variety, and viewing sites
5. Current Directory Browser: MATLAB file operations use the present directory and therefore the search path as reference points. Any file you would like to run must either be within the current directory or on the search path.
6. Search Path: To determine the way to execute functions you call, MATLAB uses an enquiry path to seek out M-files and other MATLAB-related files, which are organized in directories on your filing

system. Any file you would like to run in MATLAB must reside within the current directory or during a directory that's on the search path.

7. Workspace Browser: To view the workspace and knowledge about each variable, use the Workspace browser, or use the functions who and whos.

To delete variables from the workspace, select the variable and choose Delete from the Edit menu. Alternatively, use the clear function. The workspace isn't maintained after you finish the MATLAB session. To save the workspace to a file which will be read during a later MATLAB session, select Save Workspace as from the File menu, or use the save function. This saves the workspace to a computer file called a MAT-file, which features a .mat extension. There are options for saving to different formats. To read during a MAT-file, select Import Data from the File menu, or use the load function.

- Array Editor: Double-click on a variable within the Workspace browser to ascertain it within the Array Editor. Use the Array Editor to look at and edit a visible representation of one- or two-dimensional numeric arrays, strings, and cell arrays of strings that are within the workspace.
- Editor/Debugger: The Editor/Debugger provides a graphical interface for basic text editing, also as for M-file debugging.

You can use any text editor to make M-files, like Emacs, and may use preferences (accessible from the desktop File menu) to specify that editor because the default. If you employ another editor, you'll still use the MATLAB Editor/Debugger for debugging, otherwise you can use debugging functions, like dbstop, which sets a breakpoint.

If you only got to view the contents of an M-file, you'll display it within the Command Window by using the sort function.

## IX. MANIPULATING MATRICES

Entering Matrices, the best way for you to urge started with MATLAB is to find out the way to handle matrices. Start MATLAB and follow along with each example.

- Enter an explicit list of elements.
- Load matrices from external data files.
- Generate matrices using built-in functions.
- Create matrices together with your own functions in M-files. Start by entering Dürer's matrix as an

inventory of its elements. You have only to follow a few basic conventions:

- Separate the weather of a row with blanks or commas.
- Use a semicolon, ; , to point the top of every row.
- Surround the whole list of elements with square brackets, [ ].

To enter Dürer's matrix, simply type within the Command Window

```
A = [1 4 7 3; 15 20 31 58; 6 2 17 22; 12 14 30 40]
MATLAB displays the matrix you just entered.
A = 1  4  7  3
    15 20 31 58
    12 14 30 40
```

This exactly matches the numbers in the engraving. Once you've got entered the matrix, it's automatically remembered within the MATLAB workspace. You can refer to it simply as A.

*Expressions:*

The building blocks of expressions are:

- Variables
- Numbers
- Operators
- Functions
- Variables

## X. OUTPUT

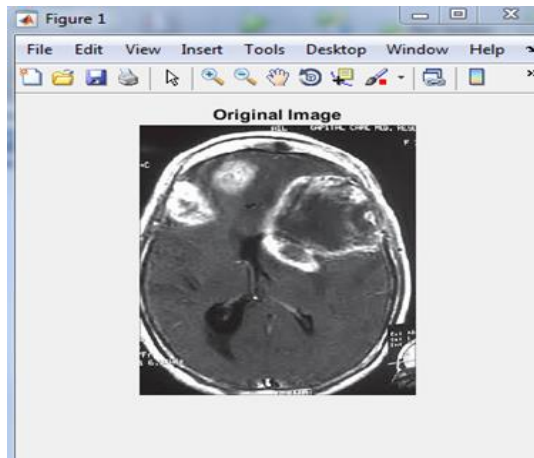
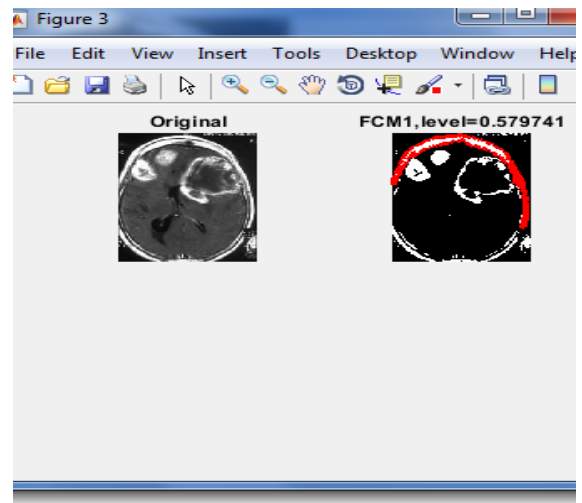
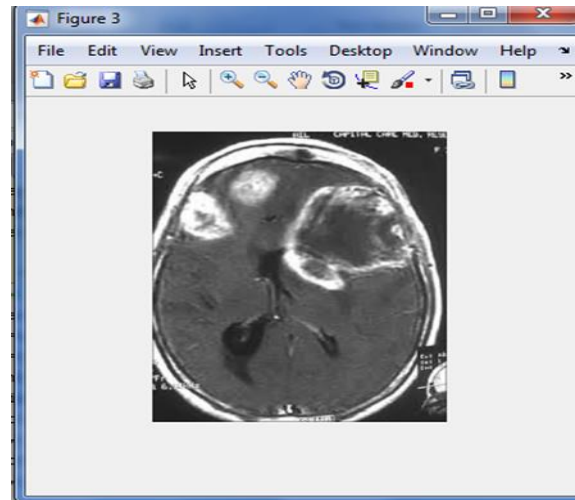


Fig.2. Original Image Brain Tumor



Fig.3. Gray Scale Image of Tumor



## XI. CONCLUSION

In this paper, we have presented three novel ConvNet architectures for grading brain tumors non-invasively, from the MR images of tumors and explore transfer learning for the same task, by fine-tuning two existing ConvNet models. An improvement about 12% in terms of classification accuracy on the test dataset was observed from deep ConvNets compared to shallow learning models. Visualizations of the intermediate layer outputs/feature maps show that kernels/filters in the convolution layers automatically learned to detect different tumor features that are closely resembled different tumor grading criteria. We also noticed that existing ConvNets trained on natural images performed adequately by only fine-tuning their final convolution layer on the MRI dataset. In our experiments, we proposed a scheme for incorporating volumetric tumor information using multi-planar MRI slices, that achieved the best testing accuracy 92.19%. So, we conclude that deep ConvNets could be a feasible alternative to surgical biopsy for brain tumors.

## REFERENCES

- [1]. T. Zaveri, and M. Zaveri, "A Novel Region Based Multimodality Image Fusion Method", *Journal of Pattern Recognition Research*, vol. 2, pp.140–153, 2011.
- [2]. V. Tsagaris, V. Anastassopoulos, and G. Lampropoulos, "Fusion of hyperspectral data using segmented PCT for enhanced color representation", *IEEE Trans. Geosci. Remote Sens.*, vol. 43, no. 10, pp. 2365–2375, 2005.
- [3]. G. Bhatnagar, Q. M. J. Wu, and Z. Liu, "Directive Contrast Based Multimodal Medical Image Fusion in NSCT Domain. *IEEE Transactions on Multimedia*, vol. 15, no. 5, pp. 1014–1024, 2013. DOI: 10.1109/TMM.2013.2244870.
- [4]. Rana, and S. Arora, "Comparative Analysis of Medical Image Fusion. *International Journal of Computer Applications*," vol. 73, no. 9, pp.10–13, 2013. DOI: 10.5120/12768-9371.
- [5]. Pinki Jain, and Anu Aggarwal, "Text Fusion in Medical Images using Fuzzy Logic based Matrix Scanning Algorithm," *International Journal of Scientific and Research Publications*, vol. 2, no. 6, pp. 1-6, 2012.