

CYBERMED INC., ONDEMAND3D TECHNOLOGY INC.

# OnDemand3D Fusion Technology

---

## White Paper

December 2009

---

● USA ● Republic of Korea  
[www.ondemand3d.com](http://www.ondemand3d.com)

Copyright(c) 1999-2009, Cybermed. All right reserved.

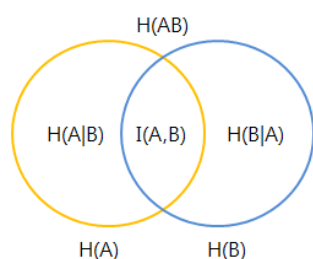
## Introduction

OnDemand3D™ Fusion is registration technology to superimpose two data scanned at different period or from different modality. By using fusion technology, Doctor can not only view aspect of changes or movements, but also understand disease symptoms easily. For OnDemand3D™ Fusion technology, mutual information from information theory is used.

## What is the Mutual Information (MI)

OnDemand3D™ fusion technology uses a basic concept from information theory, mutual information (MI), or relative entropy, as a matching criterion. Using MI in image superimposition is first suggested for registration of 3D CT, MR and PET brain images of single object (Maes F, Collignon A, Vandermeulen D, Marchal G, Suetens P. Multimodality image registration by maximization of mutual information. IEEE Trans Med Imaging 1997;16:187-98).

Simple description of this concept is as follows. MI is related to entropy by the equations



$$\begin{aligned} I(A,B) &= H(A) + H(B) - H(A,B) & (1) \\ &= H(A) - H(A|B) & (2) \\ &= H(B) - H(B|A) & (3) \end{aligned}$$

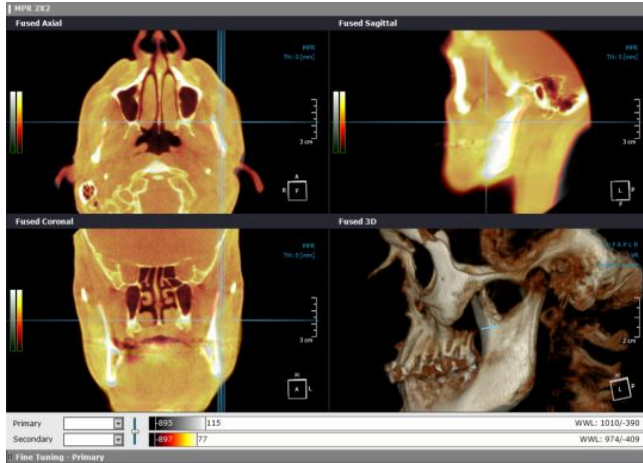
With  $H(A)$  and  $H(B)$  being the entropy of  $A$  and  $B$ , respectively,  $H(A,B)$  their joint entropy, and  $H(A|B)$  and  $H(B|A)$  the conditional entropy of  $A$  given  $B$  and of  $B$  given  $A$ , respectively. The entropy  $H(A)$  is known to be a measure of the amount of uncertainty about the variable  $A$ , while  $H(A|B)$  is the amount of uncertainty left in  $A$  when knowing  $B$ . From (2), MI,  $I(A,B)$  is the reduction in uncertainty of the variable  $A$  by the knowledge of another variable  $B$ , or equivalently, the amount of information that  $B$  contains about  $A$ .

Let us suppose  $A$  to be the information of the cranial base in pre-treatment CBCT data, and  $B$  to be that in post-treatment data. As correlation between  $A$  and  $B$  is getting higher,  $H(A|B)$  or  $H(B|A)$  becomes smaller. If cranial base areas from two data are geometrically aligned, then  $H(A|B)$  or  $H(B|A)$  is minimized and MI is maximized in (2) and (3). We can produce superimposed CBCT data by maximizing MI with translation and rotation of images.

This method was also used by Cevitanes et al to obtain geometrical information from one software package that was subsequently used in another to compare pre-segmented surface models (article in Dentomaxillofac Radiol). We expanded the scope of this method to volume imaging and slice images and also refined the algorithm and user interface. This result is a very accurate and rapid method to superimposed various images one program.

## Used for( Case study)

### Compare orthodontic surgery(pre & post operation)

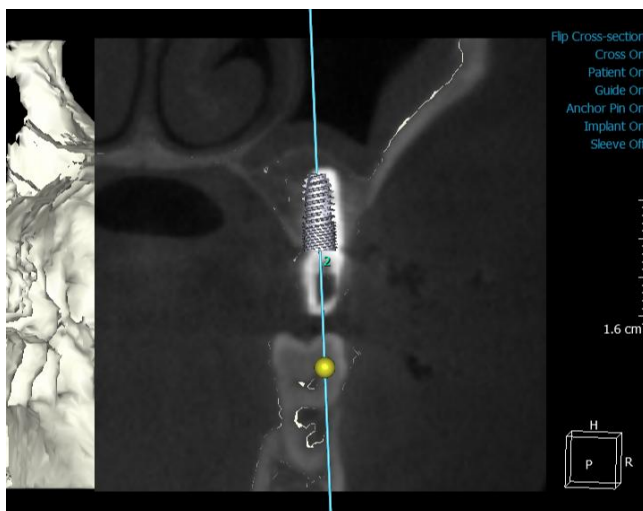


Pre-OP DICOM data and post-OP DICOM data is overlaid with Fusion Technology.



Pre-op image      Post-op image      Superimposition image

### Compare pre-implant surgery and post- implant surgery

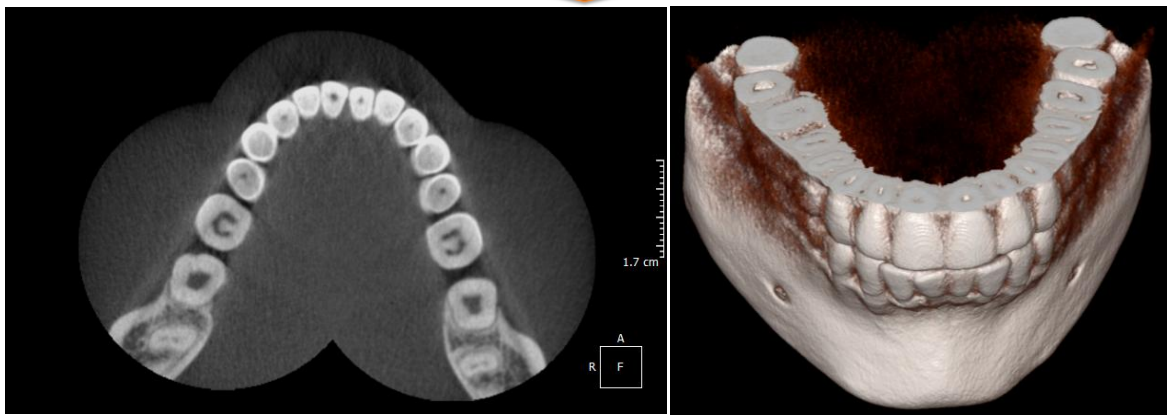


Superimposition image of post-OP scanned data and planned data. Post-op image is re-sliced after fusion Implant in order to generate the same coordinates system as pre-op. User can measure the difference with 'measure tool'.

## DATA stitching



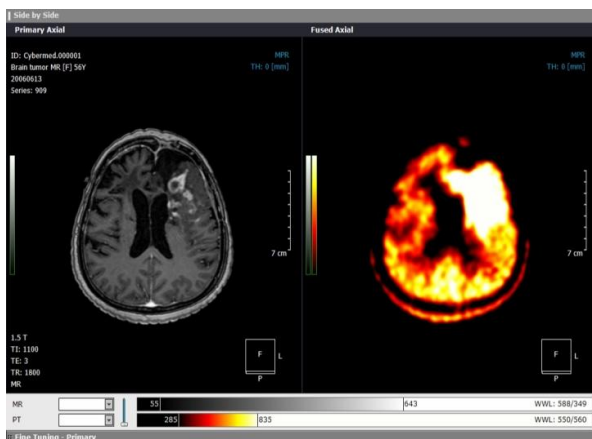
Small FOV(51mmx51mm) CT data. voxel size = 0.1mm, 512x512 matrix



Seamless stitched CT data with Fusion Technology. 912x670 matrix

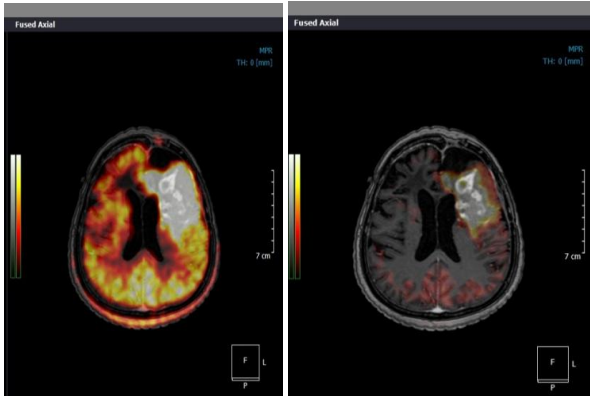
Fusion Technology enables easy stitching which is scanned DICOM data from CT with small FOV. Stitching is available from any directions (from upper, bottom, right, and left side). This technology is an automatic registration.

## CT scanned data registration from different modality



MRI Data and PET Data are combined by Fusion Technology. The quality of images and the accuracy of diagnosis are enhanced by allowing User to view both of MRI image which shows anatomical information and PET image which shows abnormal part and status of disease.

*We can offer you Advantage beyond imaging*

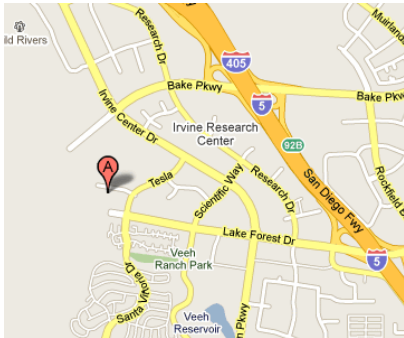


We can offer you Advantage beyond imaging



**OnDemand3D™ Fusion Technology**  
Cybermed Inc. Whitepaper

Author: OhHyung Kwon



**USA**

OnDemand3D Technology Inc.  
310 Goddard Way, Suite 250, Irvine, CA 92618, United States

Phone: 949-777-5685, 8:00AM - 5:00PM PST  
Fax: 949-777-5685  
Email: [cybermed@cyberemd.co.kr](mailto:cybermed@cyberemd.co.kr)



**Republic of Korea**

Cybermed Inc.  
504, SJ Technoville 60-19, Gasan-dong, Geumcheon-gu, Seoul, Korea

Phone: 82-2-3397-3970  
Fax: 82-2-3397-3971  
Email: [cybermed@cyberemd.co.kr](mailto:cybermed@cyberemd.co.kr)