

# **3D Digital Printing in Healthcare**

~ 3D Printing and One-stop services for medical & healthcare product development

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All-round Productivity Partner 全方位企業伙伴

#### About the speaker....



Ir Bryan SO Senior Consultant, Biomedical, Optical &Precision Engineering Unit Supervisor, Rapid Prototyping Technology Centre (RPTC) Automation Service Division

Hong Kong

With more than 12 years of experience in Advanced Manufacturing Technologies, Product Development Technologies, Medical Device Development and the related Regulatory Affairs and Quality Management System. Provides consultancy services to the medical device industry in GMP, ISO13485 quality system & ISO14971 risk management system, Pre-market notification (e.g. USFDA 510(k)), etc. Supervises the Rapid Prototyping Technology Centre in HKPC to provide consultancy services and supports to the industry on new technology development including CAD/CAM systems, micro-fabrication technology, Opto-mechatronics, micro-laser welding, 3D Printing & rapid prototyping, as well as industrial design for product development. Investigator of several government funded development projects including SME Development Fund project on ISO4971 Risk Management for Medical Devices, Medical Devices Good Distribution Practice (MDGDP), PSDAS project on Biomedical Engineering and ITF Development Project on Dental CAD/CAM system, Artificial Finger Joint, Liquid Silicone Rubber (LSR), Device on Dermoscopy for Melanoma, etc. Currently the Committee of the Biomedical Division of The Hong Kong Institution of Engineers (HKIE-Biomedical Division), the Executive Committee of the IEEE Engineering in Medical and Biological Society Hong Kong- Macau Joint Chapter (IEEE EMBS), Deputy Executive Secretary General of the Asian Harmonization Working Party (AHWP) on the harmonization of medical device regulatory and currently serving in various panels of the Hong Kong Medical and Healthcare Device Industries Association (HKMHDIA).

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### **3D printing** is gaining more positive exposure! Help spread the word by introducing your friends to the **powerful piece of technology...**"

By Barack Obama's, President of US, 12 February 2013, State of the Union Speech





"Most people probably already own something that was made with the help of a 3D printer."

"Communities offering 3D printing and other production services that are a bit like Facebook are already forming online—a new phenomenon which might be called social manufacturing."

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~The Economist Apr 2012



# **Media Attention to 3D printing**

Received more than 10 media interviews in 2013/2014 for expert advice and sharing on 3D Printing technology and engineering





新城 財經台 [14/1/2014]



頭條日報 [17/8/2013]

HKPC





## Cost-down solutions-Robohand

For roughly US\$150, the **3-D printed Robohand** lets Dylan, who is missing the fingers on one hand as a result of Amniotic Band Syndrome, grab things with bendable fingers, which most prosthetic hands don't.

Inventors have since provided free Robohands to South African children, and the open-source design has been downloaded more than 3,500 times in just three months.





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http://singularityhub.com/2013/09/13/3d-printing-delivers-functional-prosthetic-hands-at-a-diy-price/

## **Cost-down solutions-Cranial plate replacement**

#### **3D printing technology:**

Direct Metal Laser Sinstering (DMLS) Fused Deposition Modeling (FDM)

#### **Mythology:**

•Custom-made cranial plate by firstly scanning the skull using computed tomography (CT), followed by the stimulation/ remodeling of the cranial skull using 3D drawing software.

#### Materials:

•PAEK•Titanium alloy (6% Titanium and 4% Vanadium)









# **3D printing Novel Materials**



Textile

i.materialise<sup>®</sup> Rubber-Like Material [TPU 92A-1]



Food

Macronutrients Flavors and texture modifiers



#### Fibers "Shape memory" polymer fibers



#### Tissue Engineering

Living human cells



1. www.slashgear.com/3d-printing-gets-squishy-with-new-materials-from-materialise-and-shapeways-31284481/

2. sbir.gsfc.nasa.gov/SBIR/abstracts/12/sbir/phase1/SBIR-12-1-H12.04-9357.html

3. www.3ders.org/articles/20131023-cu-boulder-researchers-develop-4-d-printing-technology-for-composite-materials.html

# What is 3D Printing?



# **Additive Manufacturing**

vs subtractive manufacturing





RapidPrototyping (RP)Tooling (RT)Manufacturing (RM)

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## **Applications**











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How It Works and Where It's Headed

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Perfactory<sup>®</sup> SXGA+ Standard Zoom (DLP) www.hkpc.org/rptc

Established since 1995.

Provides one-stop consultancy

services on computer-aided design (CAD), product development, **3D** printing, as well as the bureau

services for rapid prototyping, rapid

duplication through silicone moulding,

processing, polishing & painting, optomechatronics design and fabrication,

manufacturing including PU

small batch production, post-



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### **3D Printing & Related Process**

# R&D **Rapid Prototyping** Technology Centre 快速原型科技中心 Production Regulatory & Compliance 品管課 O.C. SECTION

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**3D** Printing

FL

衛生署 Department of Health

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# **Development & Fabrication**

**Medical and Healthcare Applications** 

# **3D Printing (Rapid Prototyping)**

• Functional prototype for design evaluation and validation



### **Bone Harvesting Device for Autograft**



# 3D Digital Printing in Healthcare ~"MAGIC TREPHINE" FOR HARVESTING BONE GRAFT

An original product from Hong Kong

#### Dr Benjamin LEE

Dental Surgeon B.D.S. (Royal London Hospital University of London) The Hong Kong Japanese Dental Clinic Ltd.

7 May 2014

## **BONE GRAFTING**

# Bone tissue transplants are the second most commonly transplanted tissues, second only to blood transfusions.

### Applications for Bone Grafting:

- Spinal Fusion
- Non-Union Fractures
- Bone Defects (Congenital, Trauma, Infection, Tumours, Degeneration)
- Foot and Ankle Bone Repairs
- Plastic and Facial Surgery Reconstruction
- Dental Implants





## **BONE REMODELING PROCESS**



- **1. Osteoconduction** Guiding the reparative growth of the natural bone
- 2. Osteoinduction Encouraging undifferentiated cells to become active osteoblasts
- **3. Osteogenesis** Living bone cells in the graft material contribute to bone remodeling

Only autograft possesses all of these three properties. In particular, osteogenesis only occurs with autografts.

## **MATERIALS FOR BONE GRAFTING**



#### Other alternatives:

- Allograft (from bone bank from a cadaver)
- Bone substitutes (synthetic bone products)



harvested from iliac crest

## **MOTIVATION OF THE "MAGIC TREPHINE"**



Opening up the patient with soft tissues and muscle dissections lead to <u>more</u> <u>damage</u>, <u>more pain</u> and <u>complications</u>, and <u>too much instrumentation</u> involved in the process of bone-taking invites human errors.



## THE BIRTH OF THE "MAGIC TREPHINE"



## **ADVANTAGES OF THE "MAGIC TREPHINE"**

### Harvest ideal bone materials clean & clear:

- *Exposing it* No openly exposing the bare bone, and no involvement of the exterior bone surfaces.
- *Peeling off muscles* No soft tissue and muscle dissections nor detachments, for its sample taking.
- Fracturing it No fracturing whatsoever involved, the entire sample is simply carved out.
- Destroying it No disintegrating it, but preserving the solid sample.
- *Destroying the area site* No damaging surrounding tissues in the area of the taking.
- *Increasing the extent of damage* No opening up the site and situation beyond the size of the sample.

And as the device truly serves as a "TEMPLATE" to 3D harvest exact blocks of human bone, itself is actually 3D Printing out precise blocks of bone in Healthcare.



WITHOUT

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