(Blue lines are contents) ver2.0

Chapter 1

Introduction

(5-6 pages, at most 10 pages)

1.1 Motivation

(Introduction of the endodontic treatment)

1.2 The Prospect of this Project and Challenges

(Move to the infected teeth -¿ Root canal searching -¿ Repetitive drilling -¿ Apex Detection)
(Challenges: root canal is small, breakage of files)

1.3 Problem Definition

(Previous Work: NCTU, YOMI and even other dental robots)
(Focus on cleaning procedure)
(Two problem definition: prevent breakage of file, clean thoroughly)

1.4 Main Contributions of the Thesis

(Robot-Assisted System Design)
(Precaution against Endodontic File Fracture)
(Prediction of Direction of Root Canal and Automatic Navigation)

1.5 Organization of the Thesis

Chapter 2

The Root Canal Treatment

(Procedure) (Detailed information on paper survey)

Chapter 3

Robot-Assisted System

3.1 Requirement and Specification

(Payload, resolution and workspace)

3.2 System Design – The DentiBot

(DOF discussion, Robot Arm - Meca500, F/T sensor - Mini40, Customized Handpiece)
(Why not RCM machnism?)
(Why Meca500 and Mini40?)

Chapter 4

Kinematics and Admittance Control

(No numbers, only variables)

4.1 Kinematic Analysis

4.1.1 Coordinate Definition

(0 6, Sensor frame, and tool frame)

4.1.2 Forward and Inverse Kinematics

4.1.3 Jacobian matrix

(How to obtain Jacobian matrix in frame 6 by Jacobian matrix in frame 0)

4.1.4 Tool Center Point

(How to find RCM)

4.2 Admittance Control

4.2.1 Gravity Compensation of F/T sensor

4.2.2 Admittance Control based on F/T sensor

Control Scheme

(Block diagram, robot command choice)

Discussion about Affection of Parameter Setting

(K, Bi, Mi)

4.2.3 Reference Frame Changing of F/T sensor

(From sensor frame to tool frame)

Chapter 5

Prediction of direction of Root canal and Automatic Navigation Based on Force and Torque Feedback

5.1 Problem Definition

(Main cause of surgical failure)

5.2 The Proposed Method

(Peg in hole method based on F/T feedback)

5.3 The Implementation of the method

(Admittance control + Transformation from robot to tool + Transformation from sensor to tool + Motion Planning: based on admittance control)

5.4 Parameters Setting

(Modes: Doctor Dragging and Auto navigation)

Chapter 6

Precaution of Endodontic Files Fracture Based on Current Feedback

6.1 Problem Definition

(Main cause of Files Fracture, File analysis)

6.2 The Proposed Method and Theorem

(CACS2020)
(Motion Planning: sections)
(Current threshold setting)

Chapter 7

Preliminary Experiment Result

Chapter 8

Experimental Setup

(Acrylic root canal model)

8.1 Admittance Control

8.2 Automatically Direction Changing

8.3 Repetitive Experiment

Chapter 9

Conclusions and Future works

(Patient move tracking, root canals searching)