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Article

Graphical User Interface for Duty Calculation for MRI

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A B S T R A C T

Duty Calculation tool is a tool developed to calculate appropriate current and power duties need to be applied for particular sequence generator within a Magnetic Resonance Imaging (MRI) system. This paper provides information regarding the interface the tool and the user. Through this interface user can interact with the application through the GUI. The Duty Calculation application window displayed on the GUI is used for invocation of the application. This provides the user with various options that the user needs to execute one after the other so that the application executes accordingly.

Keywords: Duty Calculation tool, Magnetic Resonance Imaging (MRI) system, Graphical User Interface, Microsoft Visual C++

Introduction to user Interface

The interface here is explained with the help of different scenarios like:

- Duty Calculation Main GUI
- Main GUI menu options.
- Single filtered output.
- Filtered option.

Duty Calculation Main GUI

Below Figure gives the snapshot of “Main Window” of the Duty calculation application. User can invoke Duty Calculation from the following two options:

- By Double click on the “Duty Calculation” executable.
- From command line by giving “filter Setting file” and/or “Imaging Sequence File”.

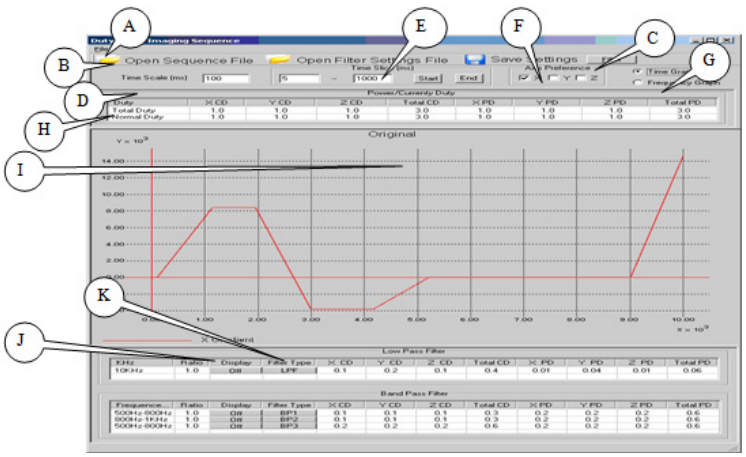

Figure 1.Duty Calculation Main GUI

All the various options present on the GUI are explained below:

Table 1.Description of Various Options Present on the GUI

S. No.	Marked Section	Description
1.	A	This will be the menu option present for the user to "Open" "Save", "Save As", "Close" or "Exit" the filter setting file and Imaging sequence file. "Save" and "Save As" will be applicable only for filter setting file. If user selects "Close" menu option, then both the imaging sequence and filter setting file will get closed.
2.	B	User can also "Open" or "Save" the filter setting file and Imaging sequence file using the toolbar option present on the GUI. "Save" will be applicable only for filter setting file. From the first Toolbar icon, user can open the "Imaging Sequence file" from second Toolbar icon user can open "Filter Settings file".
3.	C	This will be the toolbar option present for the user to apply all the available filters on the original imaging sequence file data and display the graph of the remaining frequency in the filtered section of the graph. This will be a toggle button and user can toggle between Original and Filtered graph.
4.	D	This section will display the "Time scale" value of the graph. User can also enter the time slice values directly in the edit boxes. Default Value will be 100ms.
5.	E	This section will be used by the user to select the time slice setting. User can click on the "Start" button then a slider bar will appear on the "Original" graph. On second click on "Start" button slider bar disappears. When user clicks on the "End" button another slider bar will be displayed on the "Original" waveform graph. On second click on "End" button slider bar disappears. User can also move slider by using mouse drag and drop. User can also enter the time slice values directly in the edit boxes. When user enters time slice values and presses "enter" button "Start" & "End" slider will be displayed. "Start" & "End" button will be push button style buttons.
6.	F	This section is consisting of three check boxes. User can select these check boxes in any order. User clicking order will define the preference of the plotting of "X", "Y" & "Z" gradients.
7.	G	User can switch between the "Frequency Domain" and "Time Domain" graphs of the original Imaging sequence file. This will be the radio button and only one type of graph can be displayed at a time.
8.	H	This section will display the calculated values of "Current Duty" & "Power Duty" for X, Y & Z gradients. Normal duty will display the calculation of duty values for filtered waveform and Total duty will display the calculation of duty values for remaining waveform (waveform which is not filtered).
9.	I	This section will display the original/Filtered graph, depending on the option selected. The graph display area will be a scrollable area depending upon the size of the graph drawn. Graph Display will contain horizontal and vertical scroll bar.
10.	J	This section represents the display status of a specific filter. When user clicks on any of the button, the button label will change from "Off" to "On".

11.	K	This section will represent the type of filter present. i.e. “LPF- Low Pass Filter” or “BPF – Band Pass Filter”. When user clicks on the button the specific type of filter shape will be displayed on the “Filtered” section of the GUI.
12.	-	User can resize the application and the size of the controls will increase of decrease accordingly. If size of the application is reduced below a specific size, then scroll bar will be displayed to the user to scroll the main GUI.
13.	-	“KHz” & “Ratio” columns present in the “Low Pass Filter” & “Band Pass Filters” are editable fields. By default “Band Pass” filter can display 3 filter setting values. If more than 3 values are present then scroll bar will be displayed.
14.	-	Calculated values of “CD- Current Duty” & “PD – Power Duty” in “Low pass Filter’ and “Band Pass Filter” are non-editable fields.

GUI Menu Options

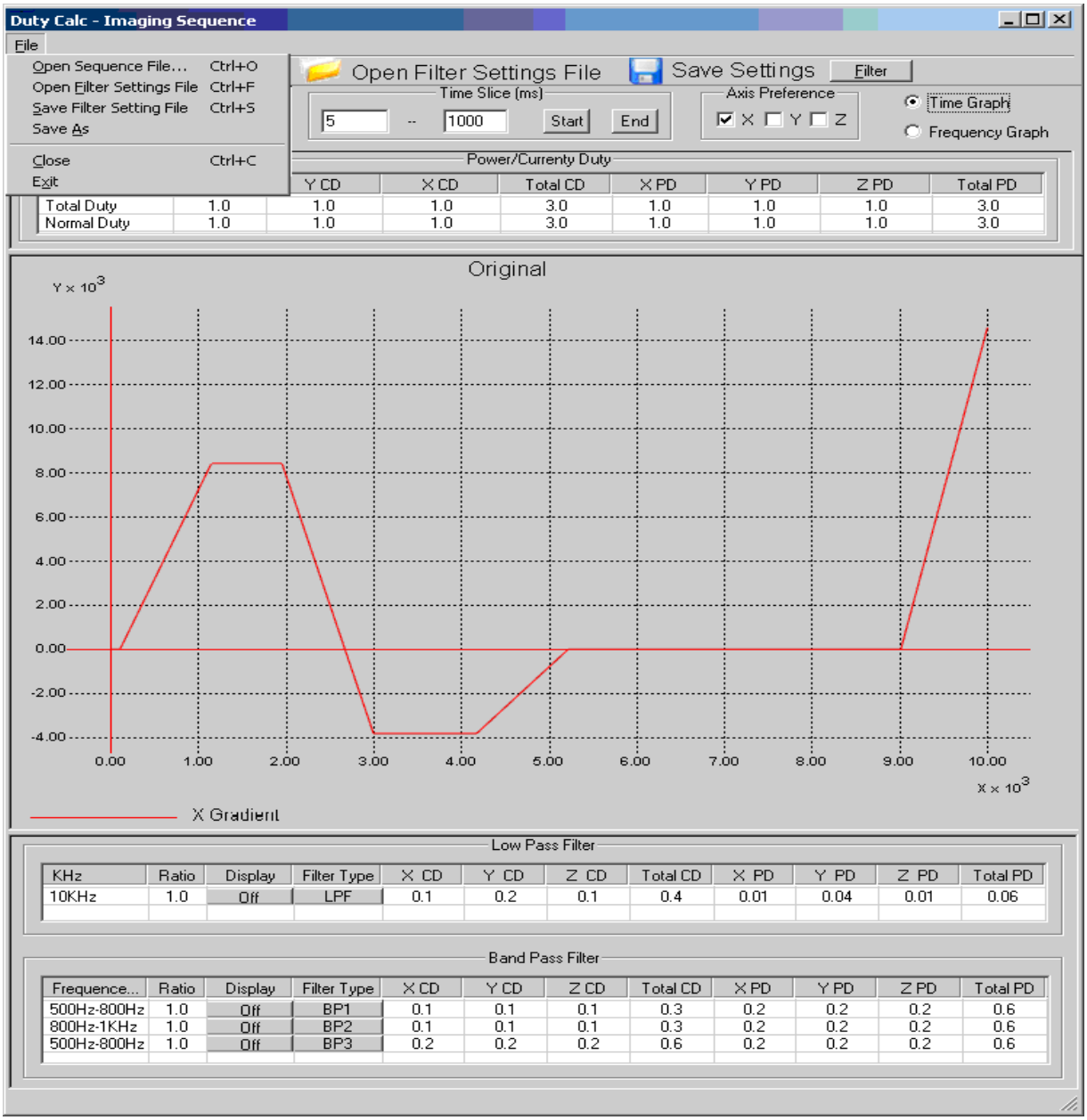

Figure 2.Main GUI Menu Options

In the above, user can use the following file menu d. User can save the filter setting file with a different options marked as “A”. name using “Save As” file option.

- User can open Imaging sequence file using “Open e. If user selects “Close” menu option, then both the Sequence File” option.
- User can open filter setting file using “Open Filter Setting File” option.
- User can save the filter setting file using “Save Filter Setting File” option.
- Single Filtered Output imaging sequence and filter setting file will get closed.
- User can exit the application either by using the “Exit” option from the file menu or by clicking on the “Close” button on the title bar.

Above figure displays the single filter selection by the user. User can view the filtered output by clicking on the “Display” button marked as “A”. In this case button label will be changed to “On”. If user again clicks on the “Display” button original graph will be displayed. Button label will again be changed to “Off”.

Above figure displays the main view when user clicks on the “Filter” button present on the main GUI toolbar.

- User can view the filtered output by clicking on the “Filter” button marked as “A”.
- If user again clicks on the “Filter” button original graph will be displayed.
- During the filter view, all the “Display” buttons, marked as “B”, will be in “On” state. User will not be able to select the individual filter option.

The remaining waveform left after application of all the filters will be displayed in GUI.

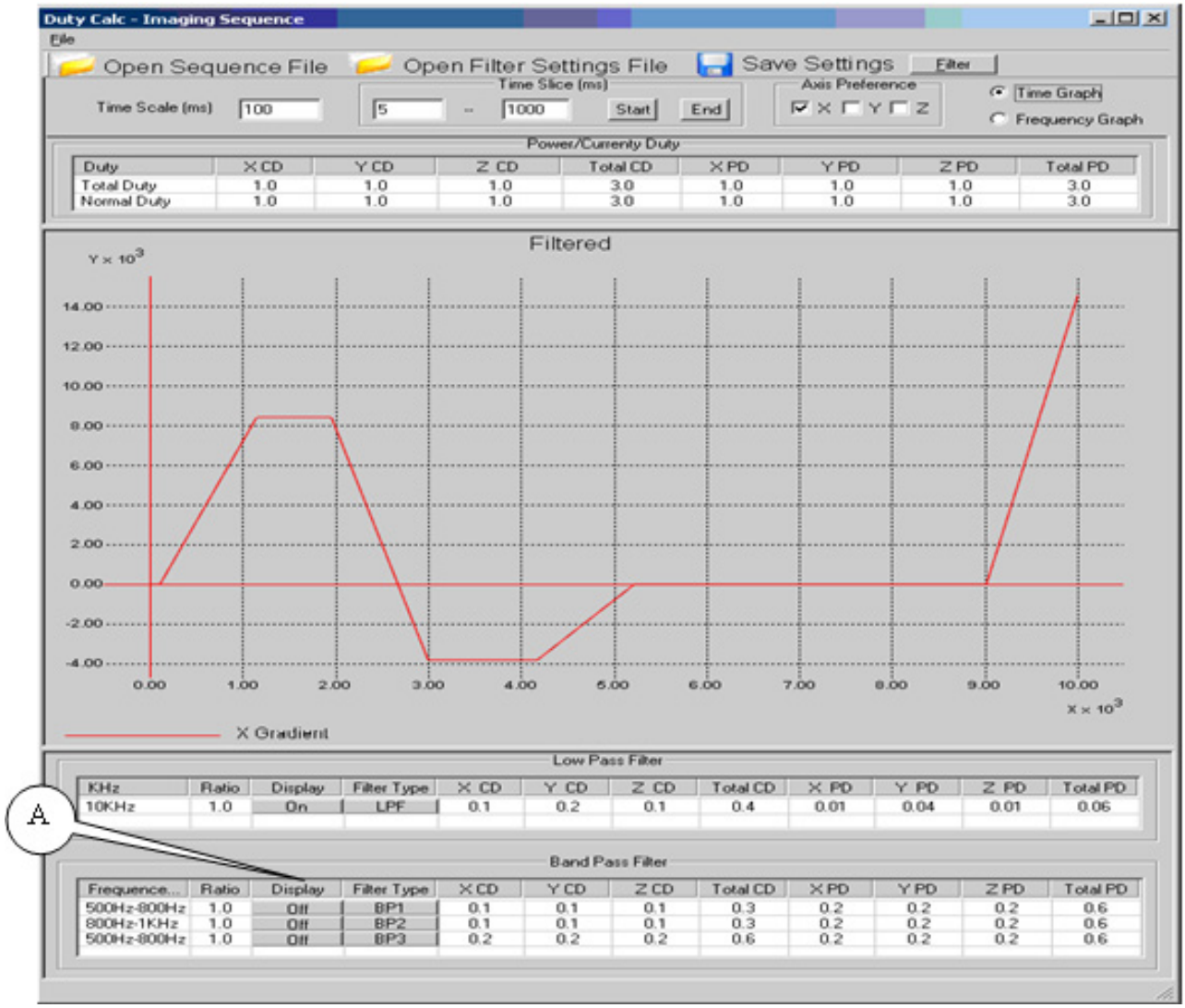

Figure 3.Single Filtered Output

Filtered Option

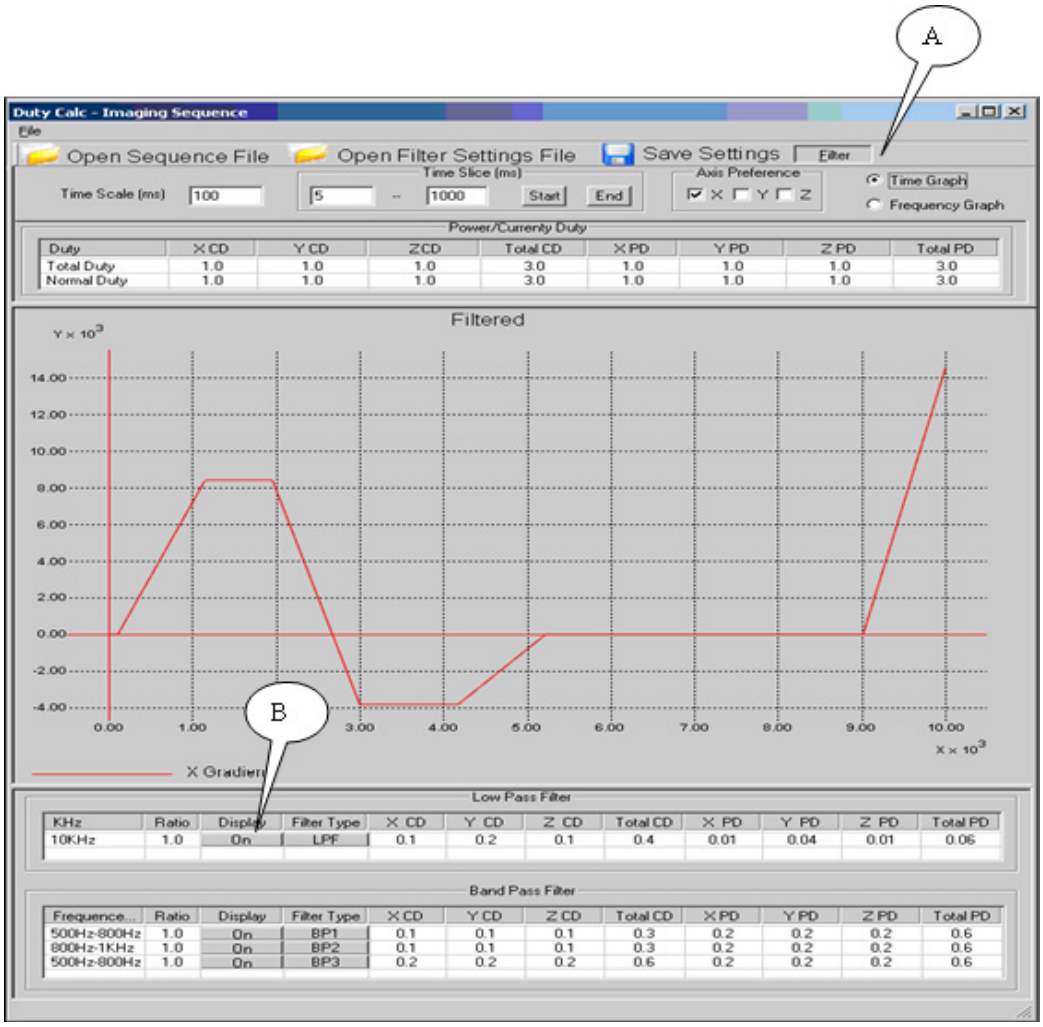

Figure 4.Filtered Option

Operating Environment

The operating environment consists of the entire software setup on the target machine to which the application is to be ported. This includes the operating system and compiler, Platform Software development kit (SDK) along with graphics Application programming interface (API) and the platform on which entire software set up for an MRI machine is loaded.

Table 2.Operating Environment

No.	Name	Version
1.)	OS	Microsoft Windows XP Professional English Version (SP 3)
2.)	Compiler	Microsoft Visual C++ 6.0 (SP 5)
3.)	Platform SDK	Microsoft Platform SDK February 2003
4.)	Direct X	Version 9.0c
5.)	MSMQ	Version 3.0
6.)	MSXML	Version 4.0 (SP2)

Table 3.Intended Users

User	Description
Software Development Engineer	Development engineer who develops/ports clinical application on MRI. Engineer who tests created components and API.
Sequence Developer	One who develops the sequence for MRI scans.
Sequence User	Application which access the MRI pulse sequence files

Conclusion

This paper provided information regarding the user interface for the Duty Calculation tool in which the Duty Calculation window displayed on the GUI after the invocation of application is described briefly Also the operating environment for the application to execute along with target user have been mentioned. This is important

because the operating environments may vary in different systems and the intended user must be aware regarding the various issues related to porting of the application to other systems.

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