

# ASSESSING THE FEASIBILITY OF SIMULATING DIFFERENT TUBE CURRENT LIMITS IN NOISE ORIENTED ATCM SYSTEMS



**IPO**PORTO

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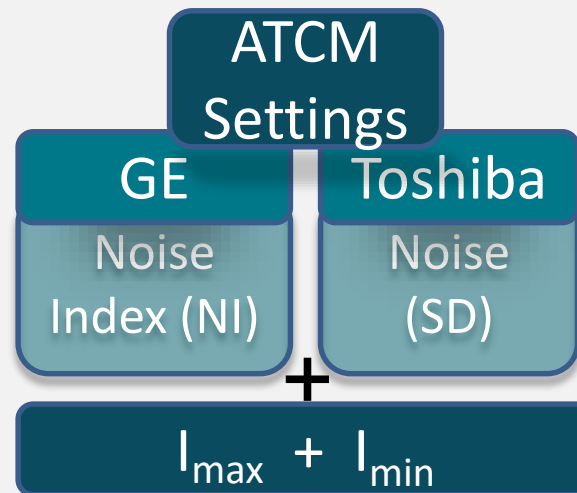
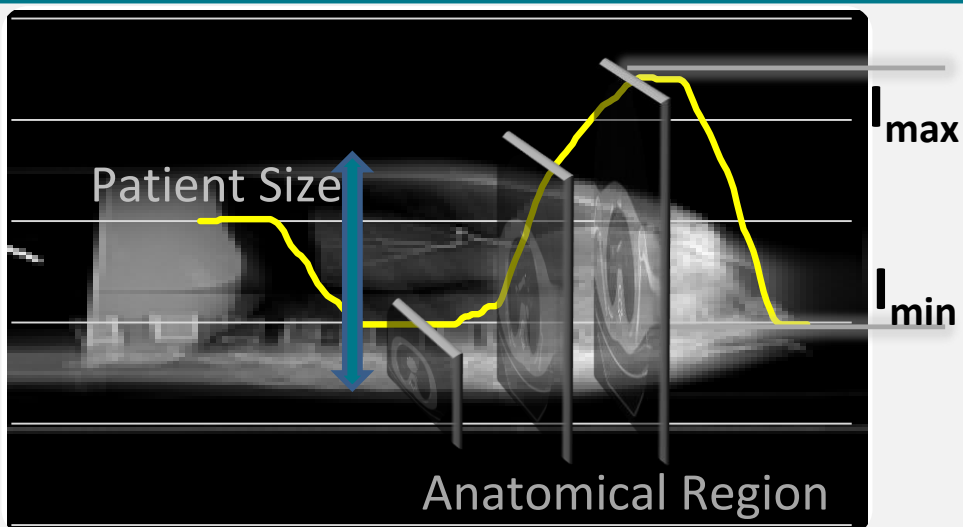
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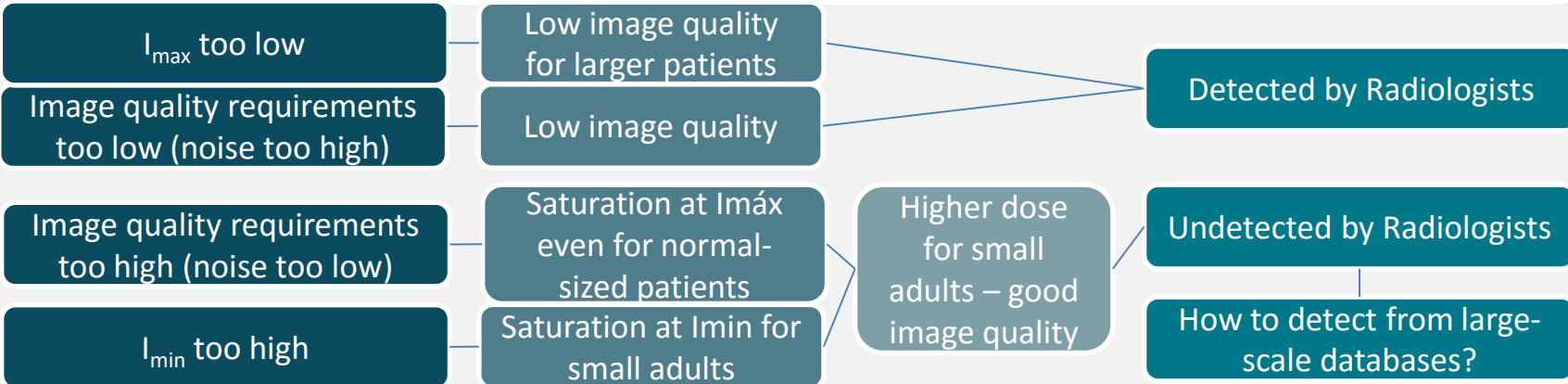
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# Introduction

## Automatic Tube Current Modulation (ATCM)



## Possible non-optimized settings (accidental protocol changes):



# Purpose

*How to detect saturation at  $I_{max}$  or at  $I_{min}$  from large-scale datasets?*

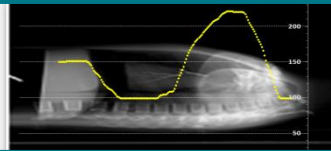
Individual size  
unknow

All patient sizes

Different Statistical  
Distributions?

Need Data for  
comparison...

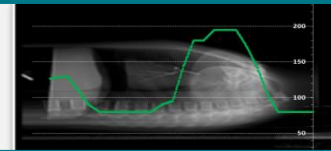
GE LightSpeed



Smart mA

Optimized  
Settings

Toshiba Aquilion RXL



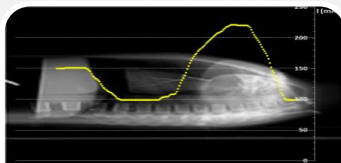
Sure Exposure 3D

- Take data from real exams contained in PACS
- Simulate mathematically different values of  $I_{min}$  and  $I_{max}$

*Is it feasible?*

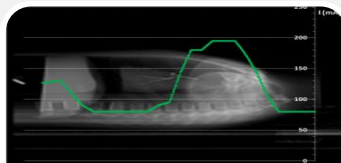
# Materials

## Chest Phantom + DICOM TAGS



### GE LightSpeed

- Smart mA
- 16 x 1.25 mm
- Slice Width: 2.5 mm
- Pitch: 1.375



### Toshiba Aquilion RXL

- Sure Exposure 3D
- 16 x 1 mm
- Slice Width: 2 mm
- Pitch: 0.938



### RS – 330 Lung/Chest Phantom (RSD, USA)

## DICOM

### File Meta Information

- Tube current
- Couch Position
- ...

### Data Set



Acquisitions with full range ATCM;  
different values of  $I_{min}$  and  $I_{max}$

# Methods

## Simulated ATCM

### Object

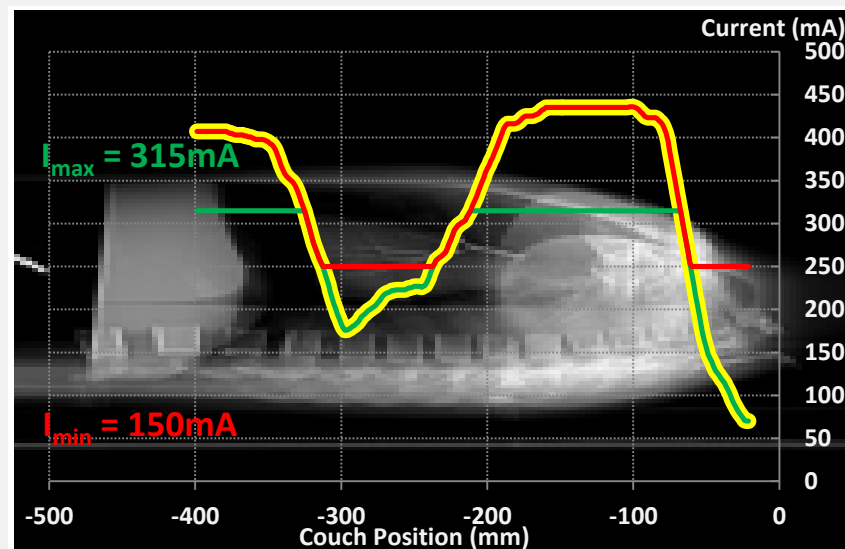
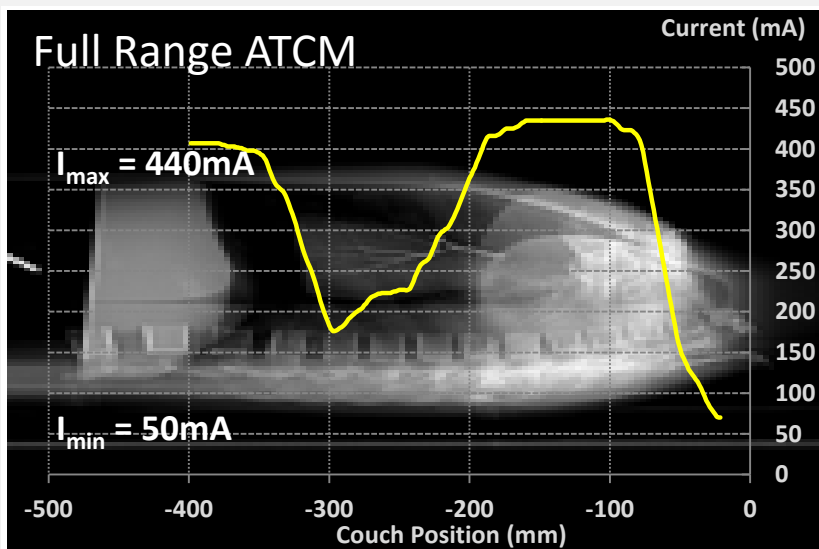
- RS – 330 Lung/Chest Phantom

### Image

- GE LightSpeed 16
- Toshiba Aquilion RXL 16
- Multiple acquisition settings

### Data analysis

- DICOM TAGS
- Tube Current
- Position

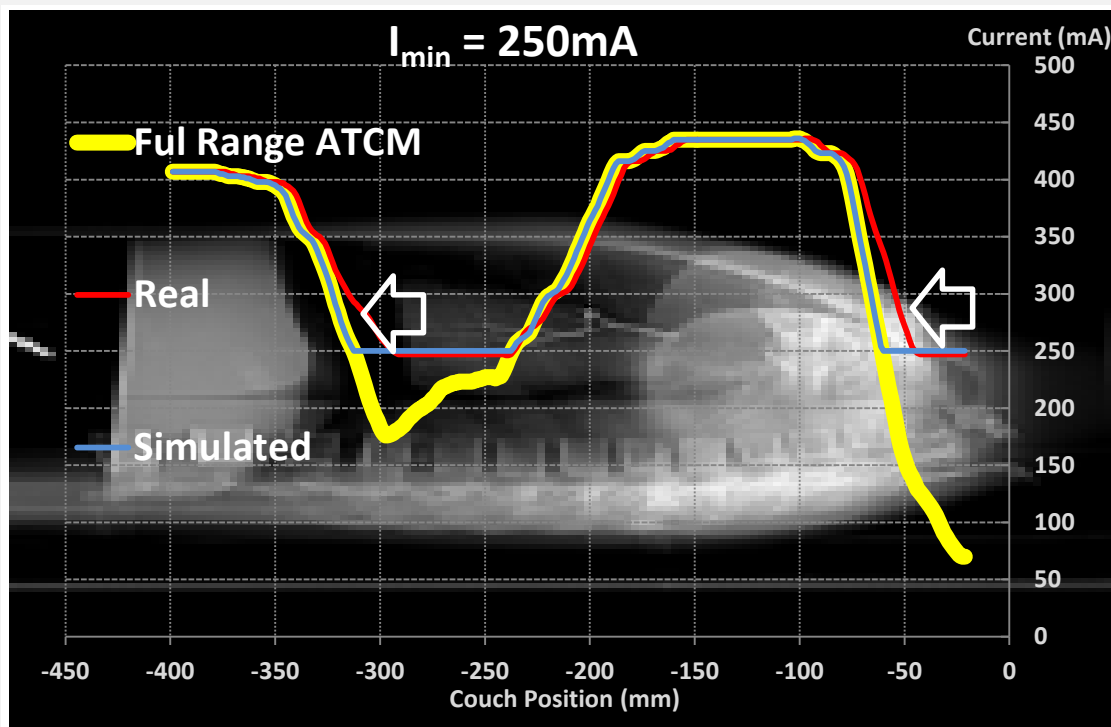


Simulation: Threshold Full Range ATCM with different values of  $I_{min}$  and  $I_{max}$

Compare with Real acquisitions

# Results

## GE LightSpeed: Real vs Simulated ATCM



### Full Range ATCM

- $I_{min} = 50mA$
- $I_{max} = 440mA$

### Simulated

Threshold Full Range  
ATCM

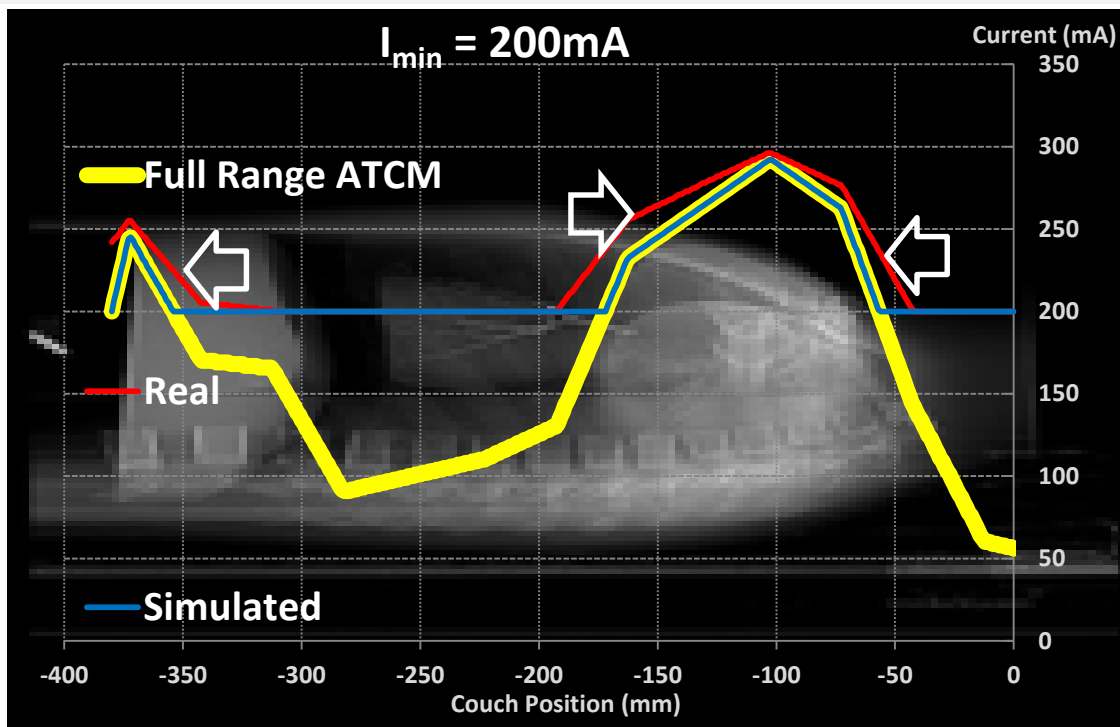
### Real

Change  $I_{min}$  in CT  
scan

Real Aquisition takes a different path  
when compared to Simulated

# Results

## Toshiba Aquilion: Real vs Simulated ATCM



### Full Range ATCM

- $I_{min} = 70\text{mA}$
- $I_{max} = 440\text{mA}$

### Simulated

Threshold Full Range  
ATCM

### Real

Change  $I_{min}$  in CT  
scan

Real Acquisition takes a different path  
when compared to Simulated

# Results

## Real vs Simulated ATCM

GE LightSpeed							
Current (mA)		$I_{\min}$			$I_{\max}$		
		125	150	250	375	315	250
Mean Value (mA)	Real	329	324	348	302	271	230
	Simulated	325	326	343	300	264	225
$\Delta$ (%)		-1%	1%	-1%	-1%	-2%	-2%
CTDI <sub>Vol</sub> (mGy)		14.5	14.3	15.5	13.2	11.2	9.6

- Simulated values have reference  $I_{\min} = 70\text{mA}$  and  $I_{\max} = 440\text{mA}$
- Differences between real and simulated inferior to 2%
- CTDI<sub>Vol</sub> of Full Range ATCM: 14.2mGy

Toshiba Aquilion							
Current (mA)		$I_{\min}$			$I_{\max}$		
		100	150	200	350	300	250
Mean Value (mA)	Real	177	197	228	171	161	148
	Simulated	176	192	219	173	173	169
$\Delta$ (%)		-1%	-2%	-4%	1%	8%	14%
CTDI <sub>Vol</sub> (mGy)		9.7	11.4	13.6	9.1	8.3	7.8

- Simulated values have reference  $I_{\min} = 50\text{mA}$  and  $I_{\max} = 440\text{mA}$
- Increase difference of simulated  $I_{\min}$  to  $I_{\text{ref}} \rightarrow$  increase difference between real and simulated
- CTDI<sub>Vol</sub> of Full Range ATCM: 9.2mGy



# Conclusions

*Is it feasible?*

## Good agreement between simulated and real curves

**CTDI<sub>vol</sub>  
differences**

Simulated  $I_{max}$  below 15%

Simulated  $I_{min}$  below 5%

Increase with:

Detailed sampling

Distance of simulated limit to upper/lower value of full range

**Real  
modulation  
curves**

Presence of fixed modulation points (grid)?

Change of upper/lower modulation levels

Different paths to achieve modulation points

Avoid sudden changes in current