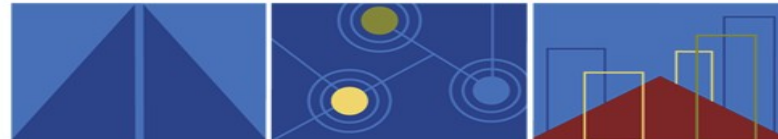


Overview and Current Status of Segmentation in Radiation Oncology

Greg Sharp
August 3, 2017

AAPM 2017



**CONNECTING OUR PATHWAYS.
UNIFYING OUR PROFESSION.**
59TH ANNUAL MEETING & EXHIBITION | DENVER, CO

Disclosures

- No conflict of interest
- I participate in research with Elekta

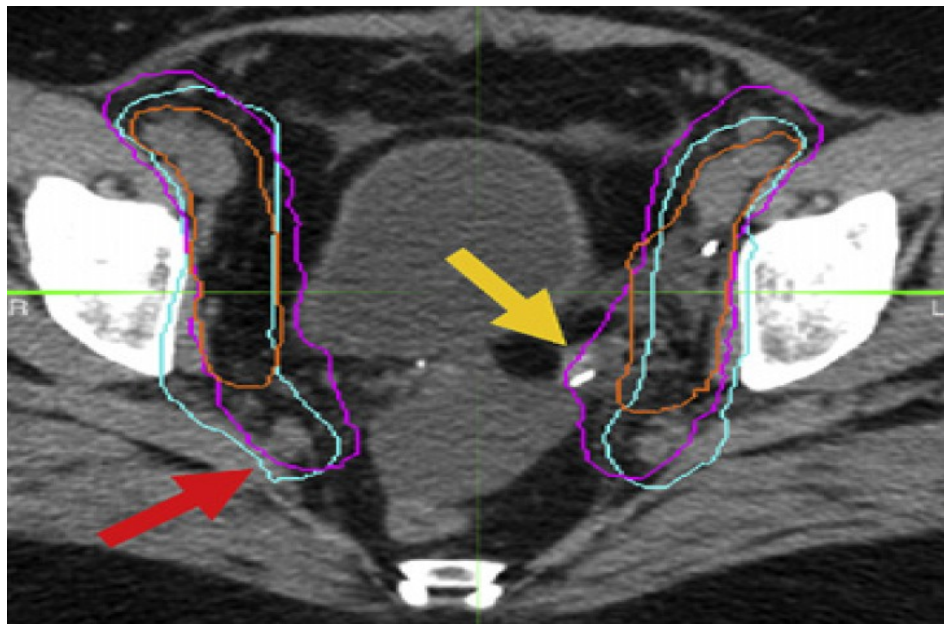


Time saving ?

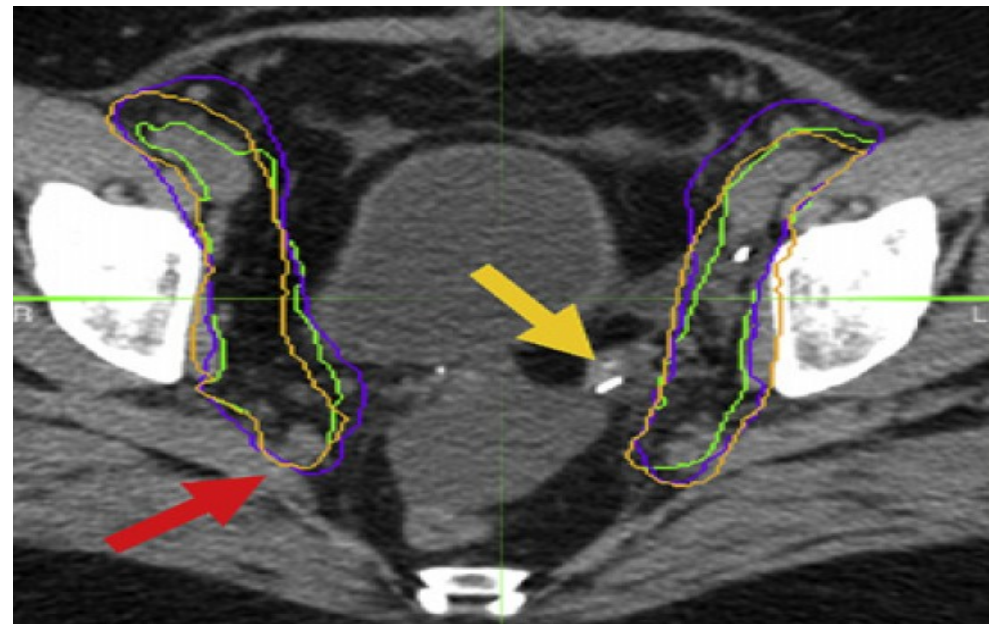
YES	NO
La Maccia 2012 Daisne 2013 Langmack 2014 Walker 2014 Eldesoky 2015	Simmat 2012 Thomson 2014



Consistency ?



Without Auto-segmentation



With Auto-segmentation

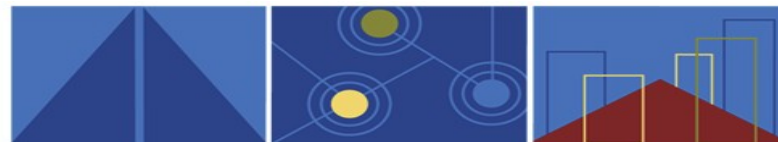
Young, IJROBP 2011

Inter-observer variability

Structure	Inter-observer variability	Automatic segmentation accuracy
Parotid gland	0.66 ± 0.1 [1] 0.76 ± 0.08 [2] 0.85 [3]	0.74 [4] [0.73,0.79] [5] 0.85 ± 0.03 [6]

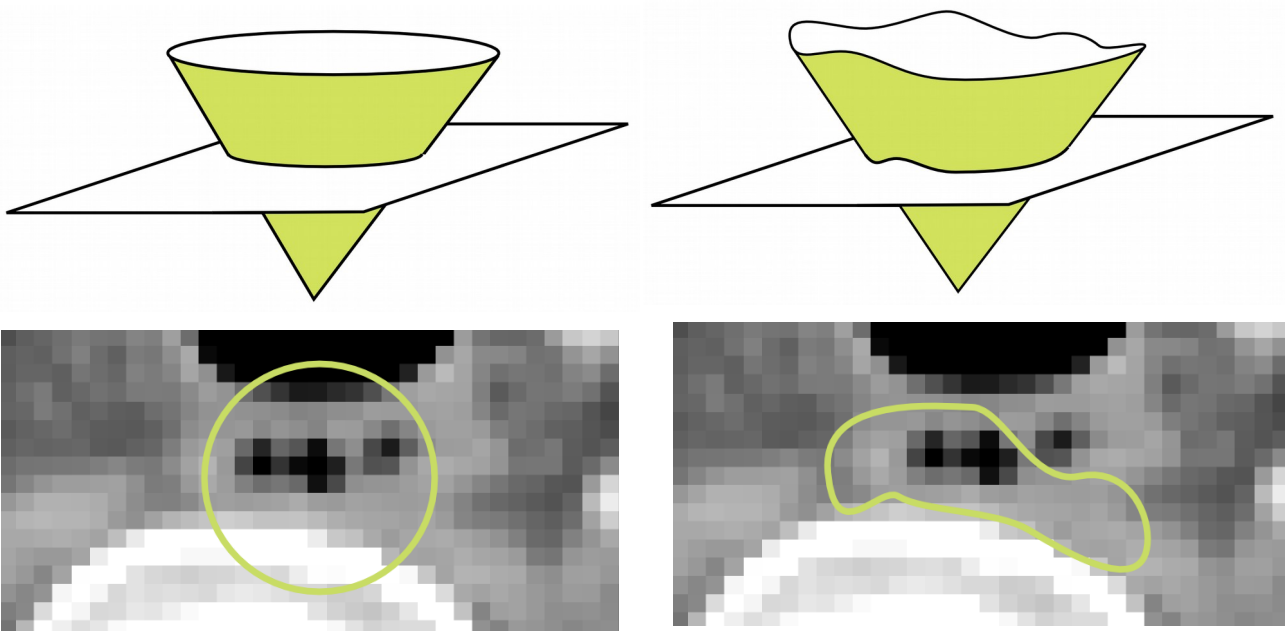
** All scores are Dice

[1] Sims, 2009, [2] Nelms, 2012, [3] Faggiano, 2011
[4] Mattiuchi, 2013, [5] La Maccia, 2012, [6] Pekar, 2010



Segmentation without prior knowledge

- Level set method

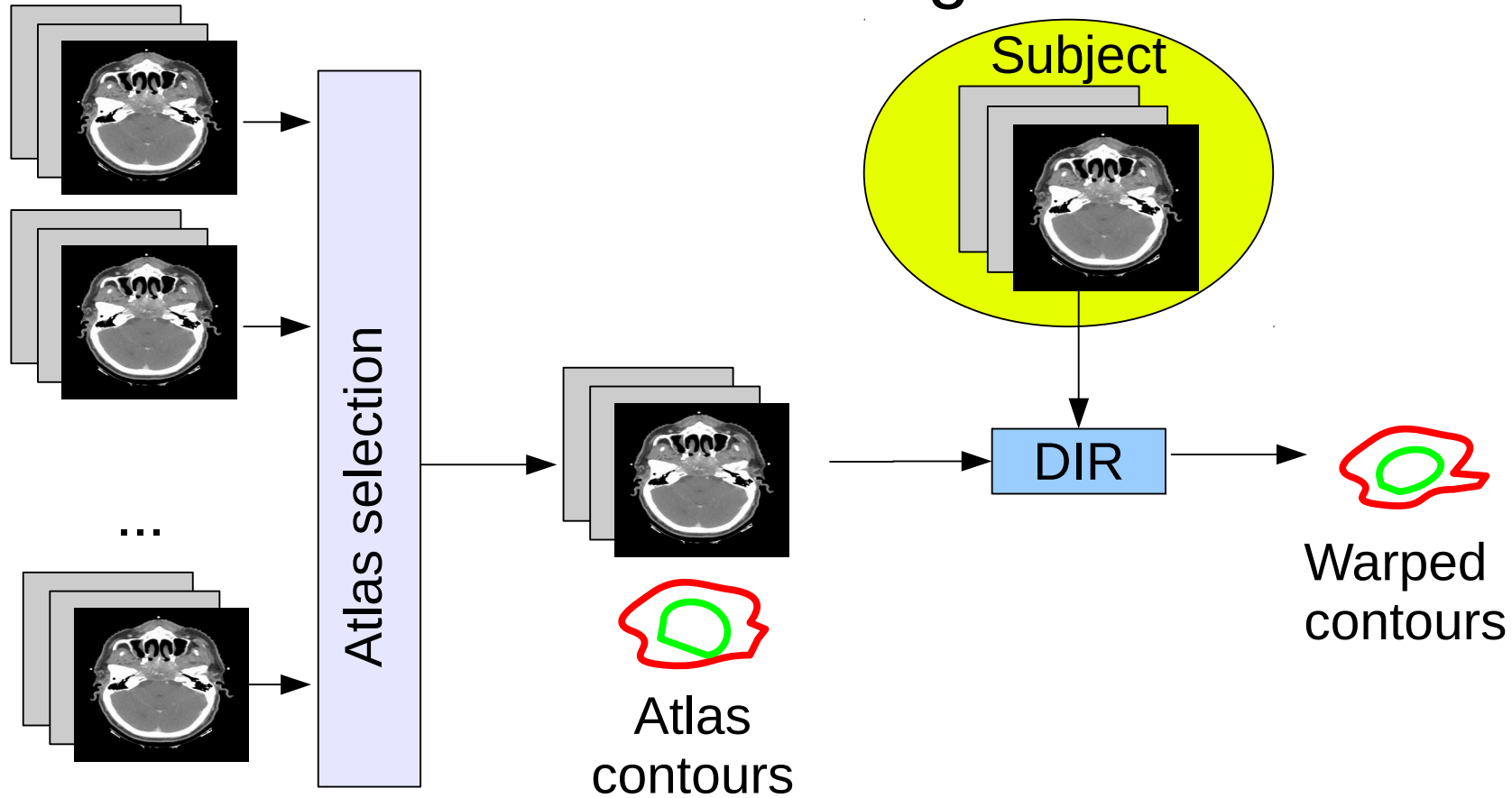


4	3	2	1	0	0	1	2
3	2	1	0	-1	-1	0	1
2	1	0	-1	-2	-1	0	1
1	0	-1	-1	-1	0	1	2
2	1	0	0	-1	0	1	2
3	2	1	0	0	1	2	3

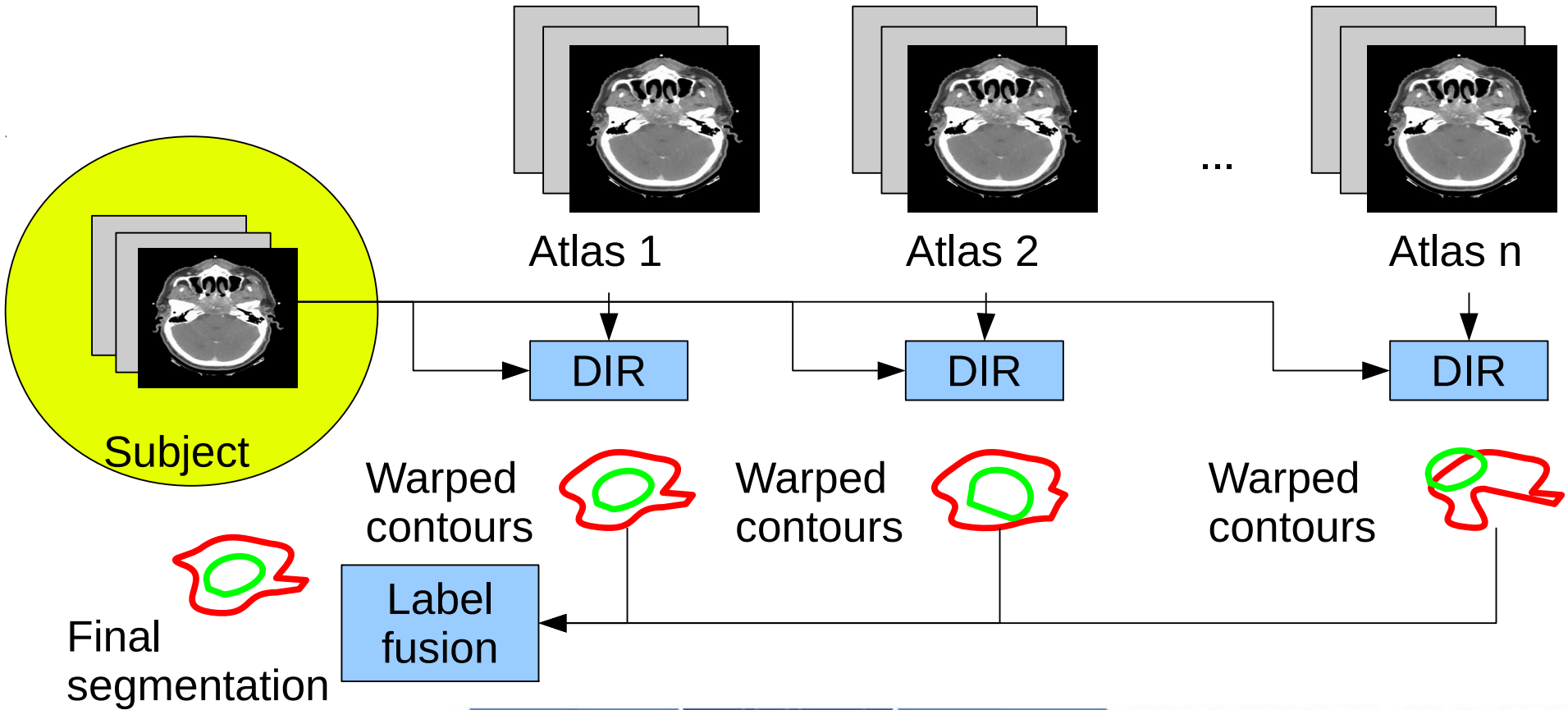
Update equation:

$$\frac{d\Psi}{dt} = -k_I (F_A + F_K) \|\nabla\Psi\|$$

Atlas-based segmentation



Multi-atlas segmentation

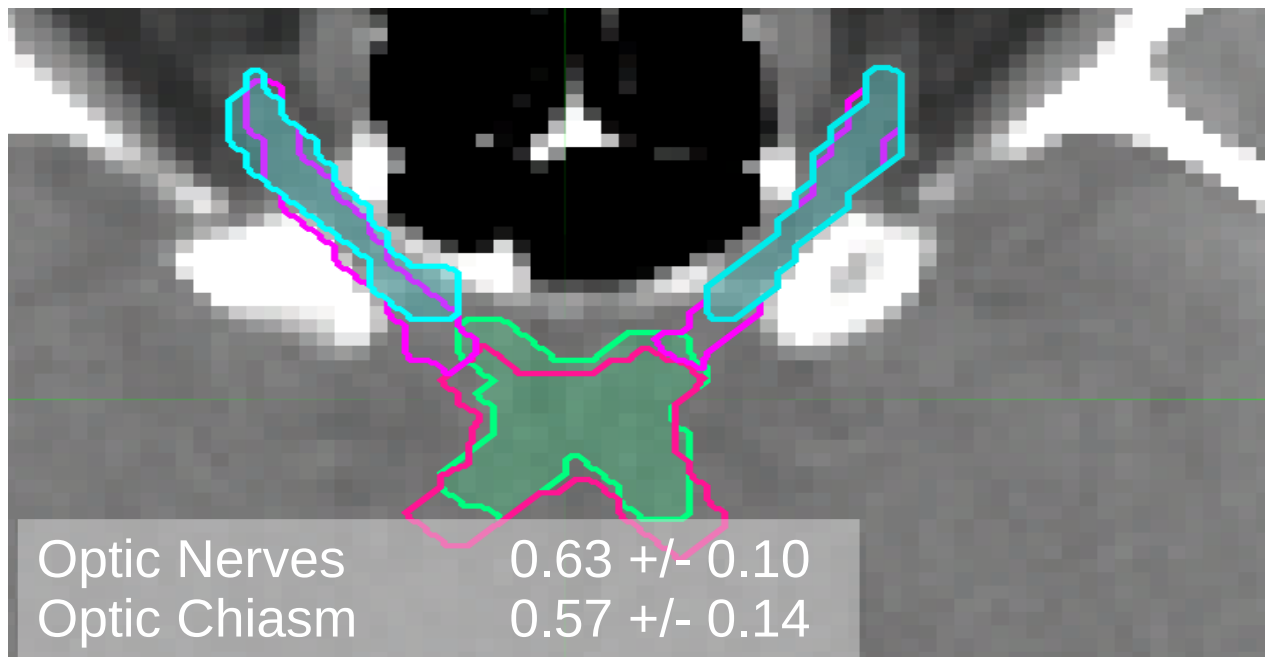


Atlas-selection

- Choose the atlas most similar to the target image
- Example:
 - Perform rigid registration against multiple atlases
 - Choose atlas that maximizes mutual information

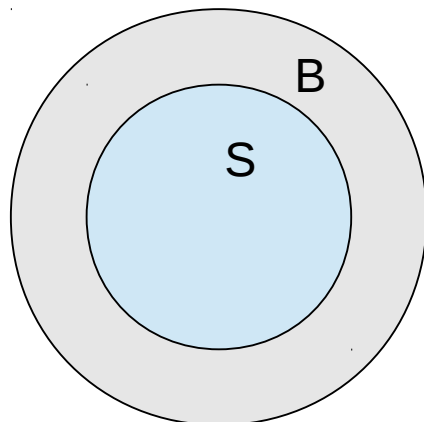
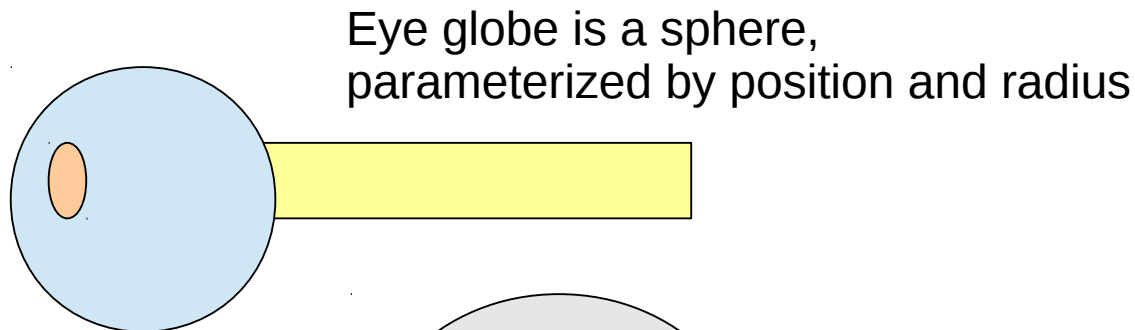
MICCAI 2015 Grand Challenge

- Top three teams – All used shape models
 - imorphics
 - BaVarian
 - Fraunhofer



Model-based segmentation

- Example



Optimize sphere parameters
to minimize an energy function

$$E(S, B) = \int_S (I - u_S)^2 - \int_B (I - u_B)^2$$

Machine learning

- Patch-based learning

