

Detection and Quantification of Growth Spurts

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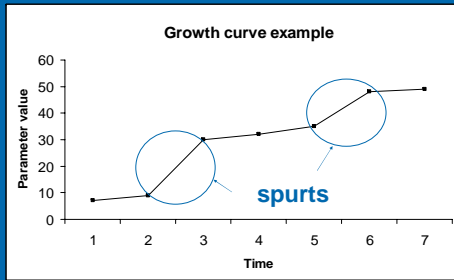
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Where are developmental **spurts**?

Spurt= local increase in growth rate or max in velocity (1st derivative)



Challenge

Noise may cause spurious spurts

Goal

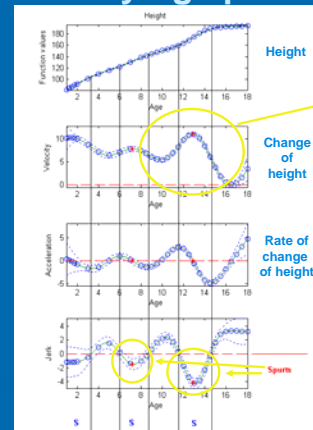
Identify and quantify **reliable spurts**

- **Where?** → location of spurt
- **How big?** → amplitude or size
- **How long?** → duration

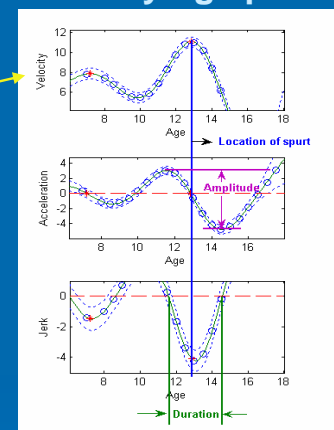
Method : Automatic Maxima Detection (AMD)

based on functional data analysis (FDA) (Ramsay, Bock et al. 1995)

Identifying spurts

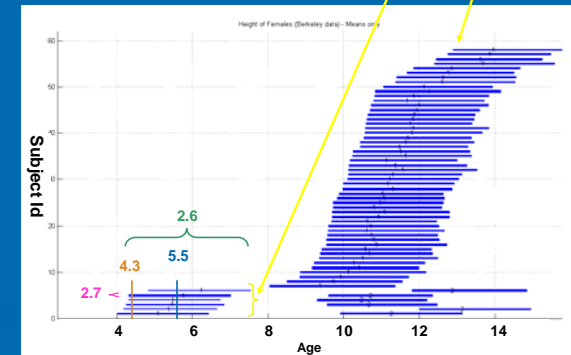


Quantifying spurts



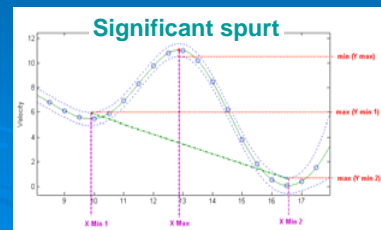
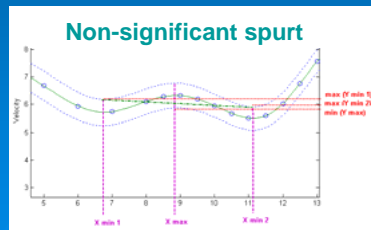
Results : Berkeley Growth Study (Tuddenham & Snyder, 1954)

Type	Boys		Girls	
	Pre-pubertal	Pubertal	Pre-pubertal	Pubertal
Found in how many participants?	8	53	6	58
Mean begin location (years)	4.8	12.3	4.3	10.3
Mean location (years)	6.2	13.5	5.5	11.4
Mean duration (years)	3.0	3.2	2.6	3.0
Mean amplitude	2.0	5.4	2.7	4.0



Significant spurt? Use confidence bands

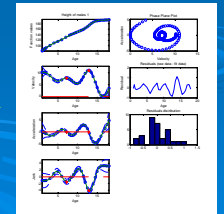
Significant spurt if the straight line connecting minima (green line) goes outside the confidence bands



Input

Subject	Age	Height
1	1	81.5
1	1.25	84.2
1	1.5	86.1
1	1.75	88.3
1	2	91.4
1	2.25	95.1
1	2.5	99.1
1	2.75	103.4
1	3	108.8
1	3.25	115.3
1	3.5	123.0
1	3.75	131.9
1	4	141.1
1	4.25	150.7
1	4.5	160.5
1	4.75	170.4
1	5	180.3
1	5.25	190.3
1	5.5	198.1
1	5.75	205.4
1	6	212.2
1	6.25	218.1
1	6.5	222.4
1	6.75	225.4
1	7	227.4

Output



Conclusion : Automatic detection and quantification of growth spurts