

Video image analysis of live lambs to predict live weight, carcass composition and meat quality

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Introduction

- Predictors of carcass and meat quality are required:
 - that can be measured in the live animal
 - preferably at a young age, on-farm
 - with minimum stress to the growing animal
- Promising results using Video Image Analysis to predict composition in live pigs and cattle
- Potential of video image analysis in sheep:
 - to help meet target carcass requirements?
 - for predicting traits relating to meat quality?



Aim

To investigate the use of linear dimensions obtained from live animal video image analysis (LVIA) to assess:

- live weight
- carcass composition
- meat quality (MQ)

in lambs of two divergent breeds

Methods



- Mixed batches of lambs finished for slaughter (based on live wt + c.s.):
 - Texel (TEX, n=113) and Scottish Blackface (SBF, n=103)
 - male and female
 - age range 101-205d
- Shorn and photographed
- Slaughtered and dissected
 - 2 to 29d later
- MQ analysis

Texel and Blackface, wool on and shorn

WOOLY



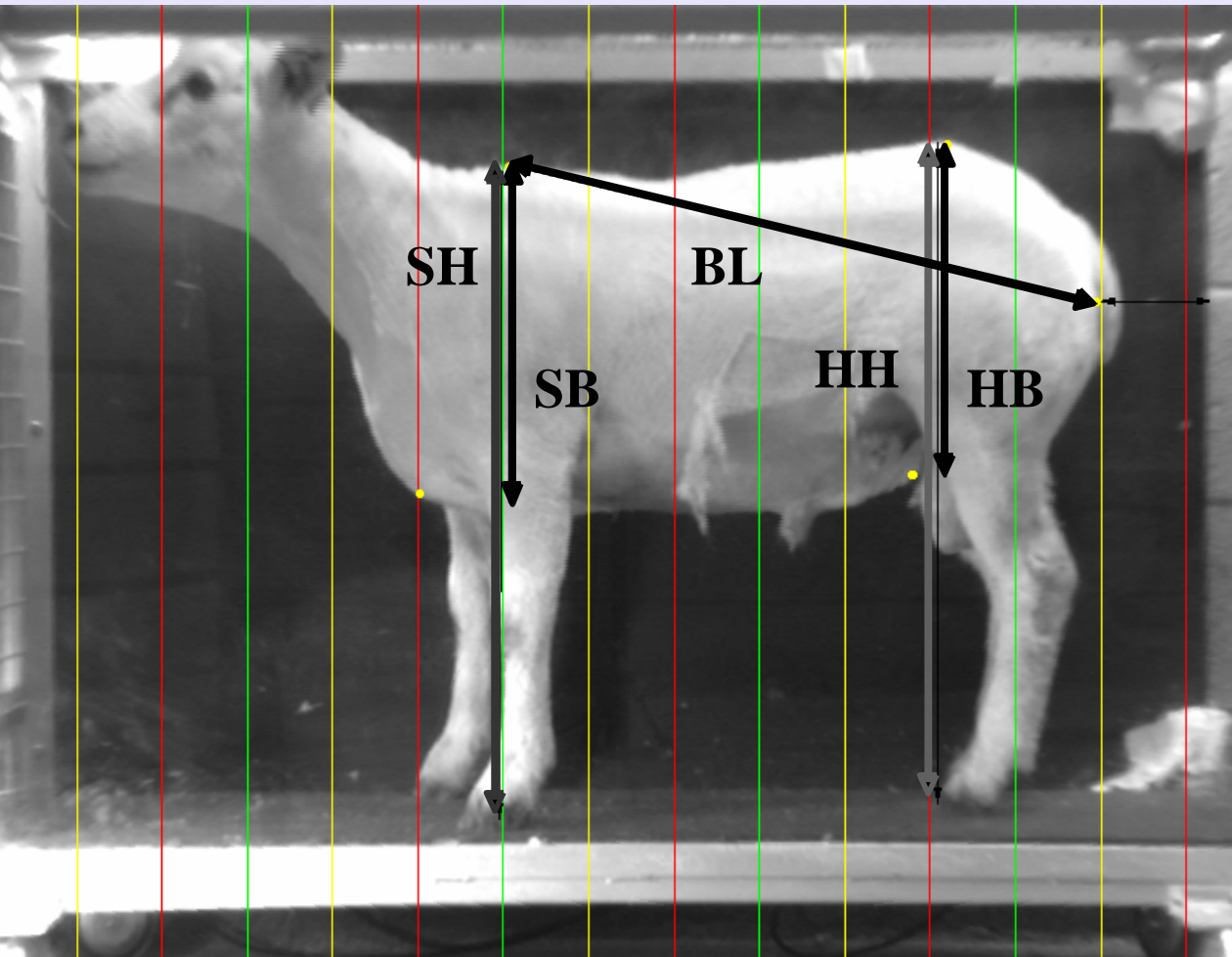
SHORN



TEXEL

SCOTTISH BLACKFACE

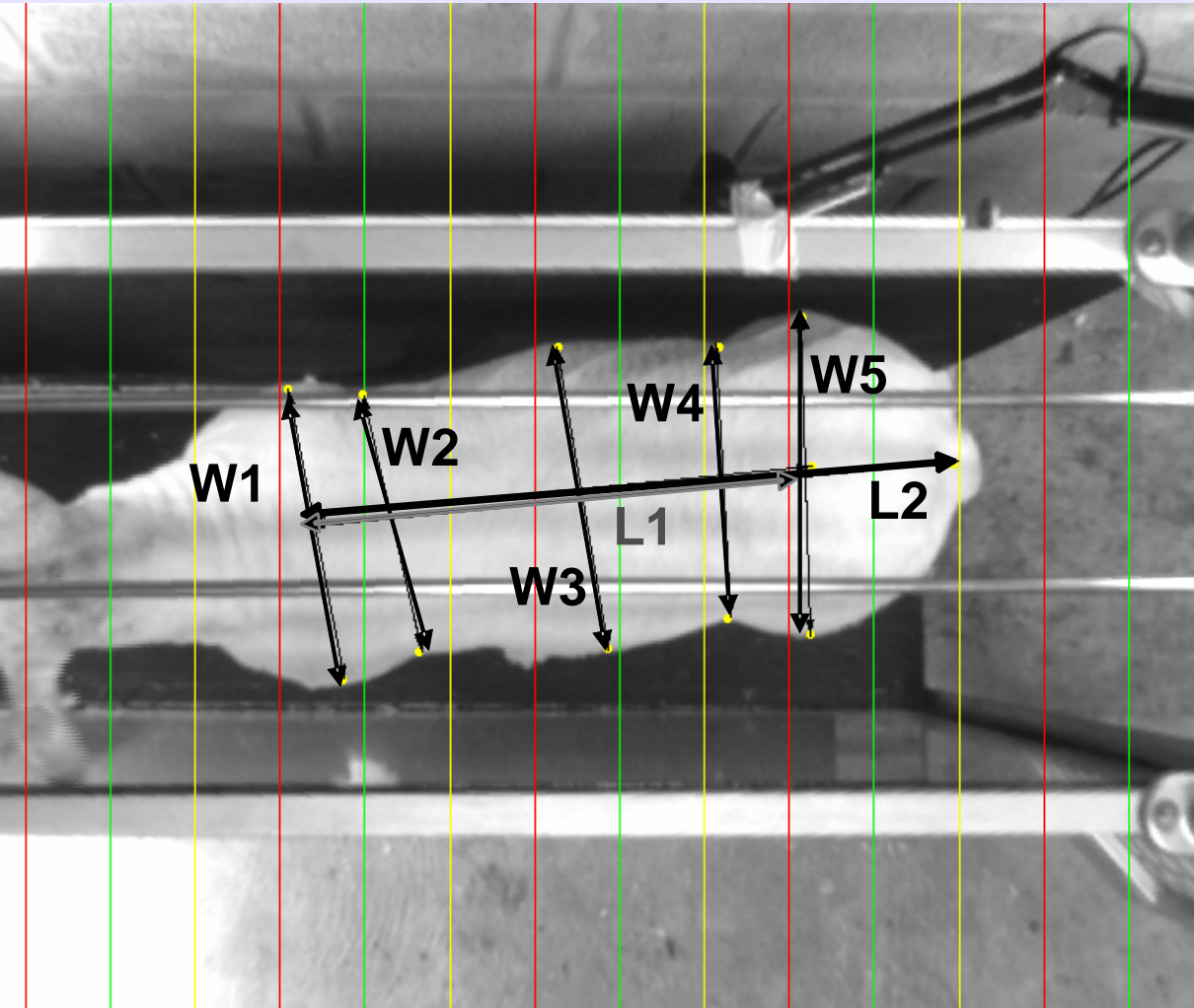
Side View



SB - shoulder body depth
SH - shoulder height
BL - body length
HB - hind body depth
HH - hind height

LVIA measurements

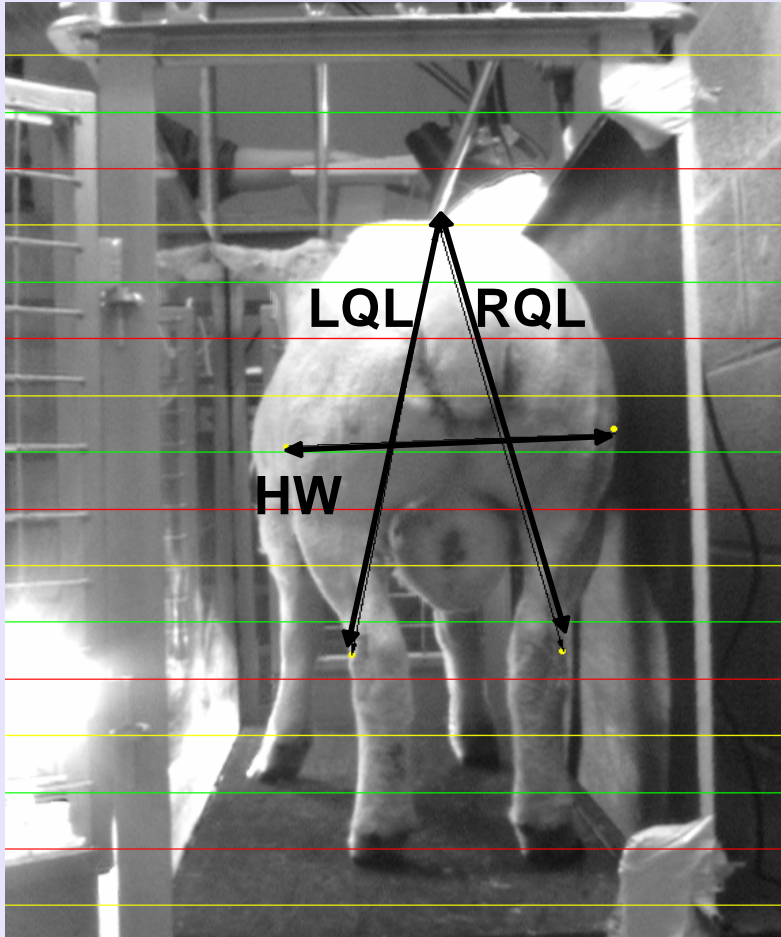
Top View



- W1 - width at shoulder
- W2 - width behind shoulder
- W3 - widest mid width
- W4 - width in front of rump
- W5 - width of rump
- L1 - length shoulder to W5
- L2 - length shoulder to tail

LVIA measurements

Rear View



LQL – left quarter length
 RQL – right quarter length
 HW – hind width

$$AvQL = (LQL+RQL)/2$$

Statistical Analysis

- Multiple linear regression to predict:
 - Live weight at LVIA
 - Carcass composition
 - dissected muscle wt in carcass side (DMWT)
 - dissected fat wt in carcass side (DFWT)
 - Meat quality traits
 - chemically extracted intramuscular fat in the loin (IMF)
 - shear force of leg (ShF LEG) and loin (ShF LOIN)
 - ultimate pH in leg (pH LEG) and loin (pH LOIN) muscles

Statistical Analysis

- Models fitted included:
 - age (model 1) or live weight (model 2) at LVIA
 - days between LVIA and slaughter
 - sex
 - best combinations of LVIA dimensions
 - by comparing residual standard deviations, Mallows coefficient and adjusted R^2
- Compared to models using covariates and sex only to predict product quality traits (no LVIA)

Results – Live weight



<i>Model</i>	Texel		Blackface	
	<i>adj-R²</i>	<i>LVIA dimensions</i>	<i>adj-R²</i>	<i>LVIA dimensions</i>
No LVIA (covariates+sex only)	0.36		0.34	
+ best single LVIA predictor	0.66	W2	0.47	W3
+ best single LVIA view	0.73	top	0.57	top
+ best LVIA combination	0.84	HW,HB,SB, L1,W1,W2 (all positive)	0.67	HW,HB,SB, L1,W2,W3 (all positive)

Results – muscle (DMWT) and fat (DFWT)



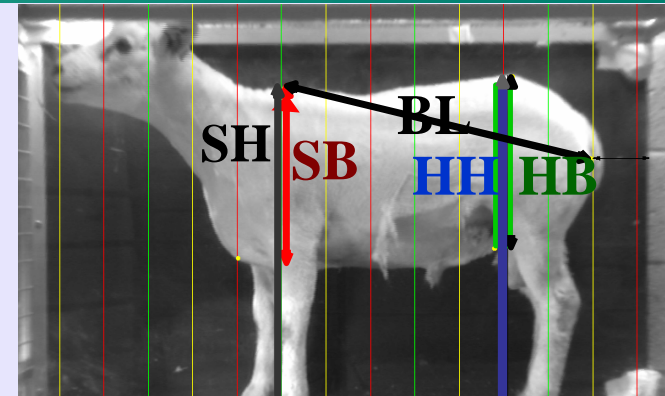
Model	Trait	Texel (<i>adj-R²</i>)		Blackface (<i>adj-R²</i>)	
		No LVIA	Best model	No LVIA	Best model
Model 1 (incl. age)	DMWT	0.36	0.73	0.13	0.64
	DFWT	0.27	0.54	0.23	0.69
Model 2 (incl. LWT)	DMWT	0.66	0.76	0.18	0.63
	DFWT	0.53	0.62	0.26	0.69

- With LVIA higher prediction accuracies for:
 - live wt (LWT) and muscle wt (DMWT) in TEX - leaner breed
 - fat wt (DFWT) in SBF - fatter breed
- Top view most valuable set of dimensions to predict tissue wts

Results – muscle (DMWT) and fat (DFWT)

DMWT generally associated with:

- increased lengths, widths and SB
- decreased rear height (HH, AvQL)
- decreased mid-width (W3: gut-fill?)
- higher in males



DFWT generally associated with:

- increased lengths, widths and SB
- decreased rear body depth in SBF (HB, AvQL)
- decreased shoulder height (SH) in TEX
- decreased mid-width (W3)
- higher in females



Results – MQ traits

Model	Trait	Texel (<i>adj-R²</i>)		Blackface (<i>adj-R²</i>)	
		No LVIA	Best model	No LVIA	Best model
Model 1 (incl. age)	IMF	0.19	→ 0.38	0.10	→ 0.40
	pH LEG	0.02	0.20	0.04	0.13
	pH LOIN	0.03	0.22	0.07	0.09
	ShF LEG	0.17	0.19	0.01	0.10
	ShF LOIN	0.29	→ 0.32	0.08	0.19
Model 2 (incl. LWT)	IMF	0.33	→ 0.43	0.12	→ 0.36
	pH LEG	0.07	0.26	0.09	0.13
	pH LOIN	0.07	0.24	0.05	0.12
	ShF LEG	0.17	0.19	0	0.09
	ShF LOIN	0.30	→ 0.31	0.01	0.18

Results – MQ traits

- IMF predicted with moderate accuracy
 - In general similar associations with LVIA traits as DFWT
 - DFWT and IMF highly correlated
 - $r = 0.79$ TEX
 - $r = 0.67$ SBF
 - Different combinations of LVIA dimensions significant, different co-efficients

Conclusions

- LVIA accurately predicts weight and composition of finished shorn lambs
- Dimensions predicting composition reflect changes in tissue distribution with maturity (Hammond, 1940)
- Substantially improves the estimation of IMF, but not sufficiently accurate to predict shear force or pH
- Potential use to select slaughter lambs (on weight and composition), using cameras in a finishing shed
 - non-invasive, non-disruptive
 - shearing required
 - breed differences need to be considered

Acknowledgements

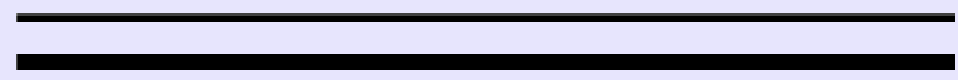
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