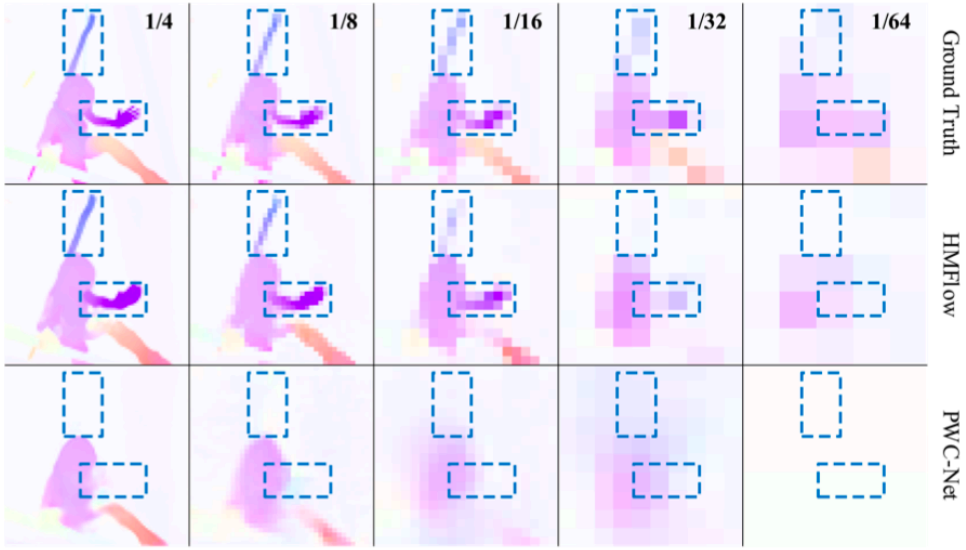
HMFlow: Hybrid Matching Optical Flow Network for Small and Fast-Moving Objects

Suihanjin Yu, Youmin Zhang, Chen Wang, Xiao Bai, Liang Zhang
School of Computer Science and Engineering
Beihang University
Beijing, China
Email: {fakecoderemail, youmi, wangchenbuaa, baixiao, liang.z}@buaa.edu.cn

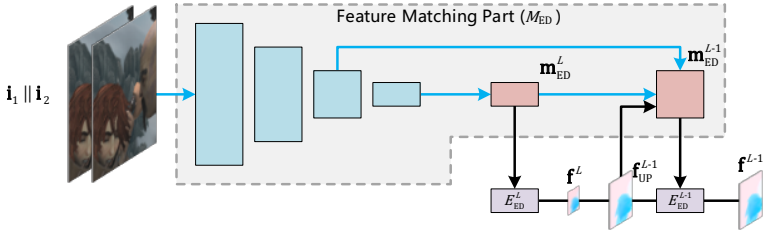
Edwin R. Hancock
Department of Computer Science
University of York
York, UK
Email: erh@cs.york.ac.uk

- The Flow Spatial Pyramid

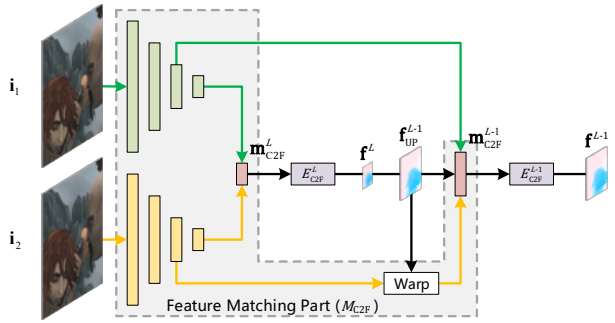


Problem Analysis

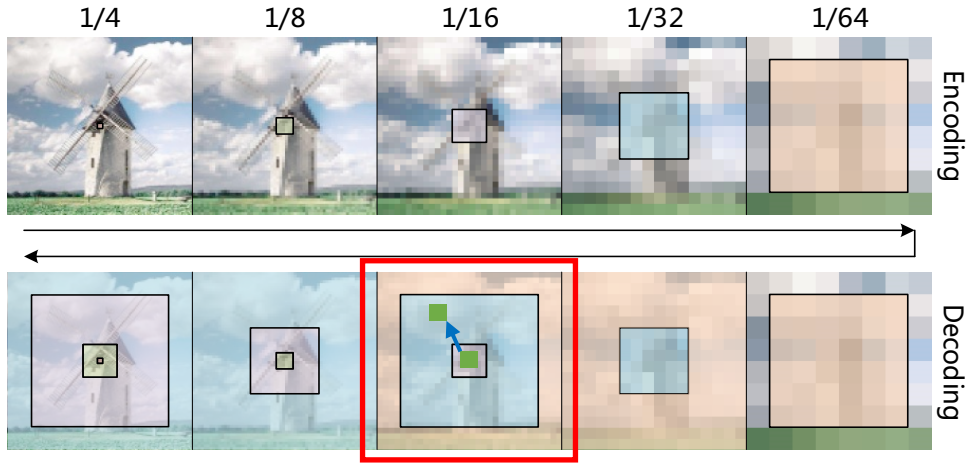
- Encoder-Decoder Network
  - ❑ Possess strong flexibility with large size of model parameters
  - ❖ High computing cost

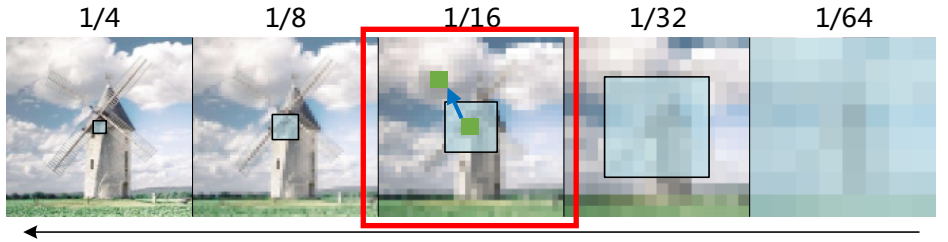


- Coarse-to-Fine Network
  - ❑ Warping strategy to provide accuracy and speed
  - ❑ Small model size
  - ❖ Fail to capture small and fast-moving objects



Receptive Field





Architecture of HMFlow

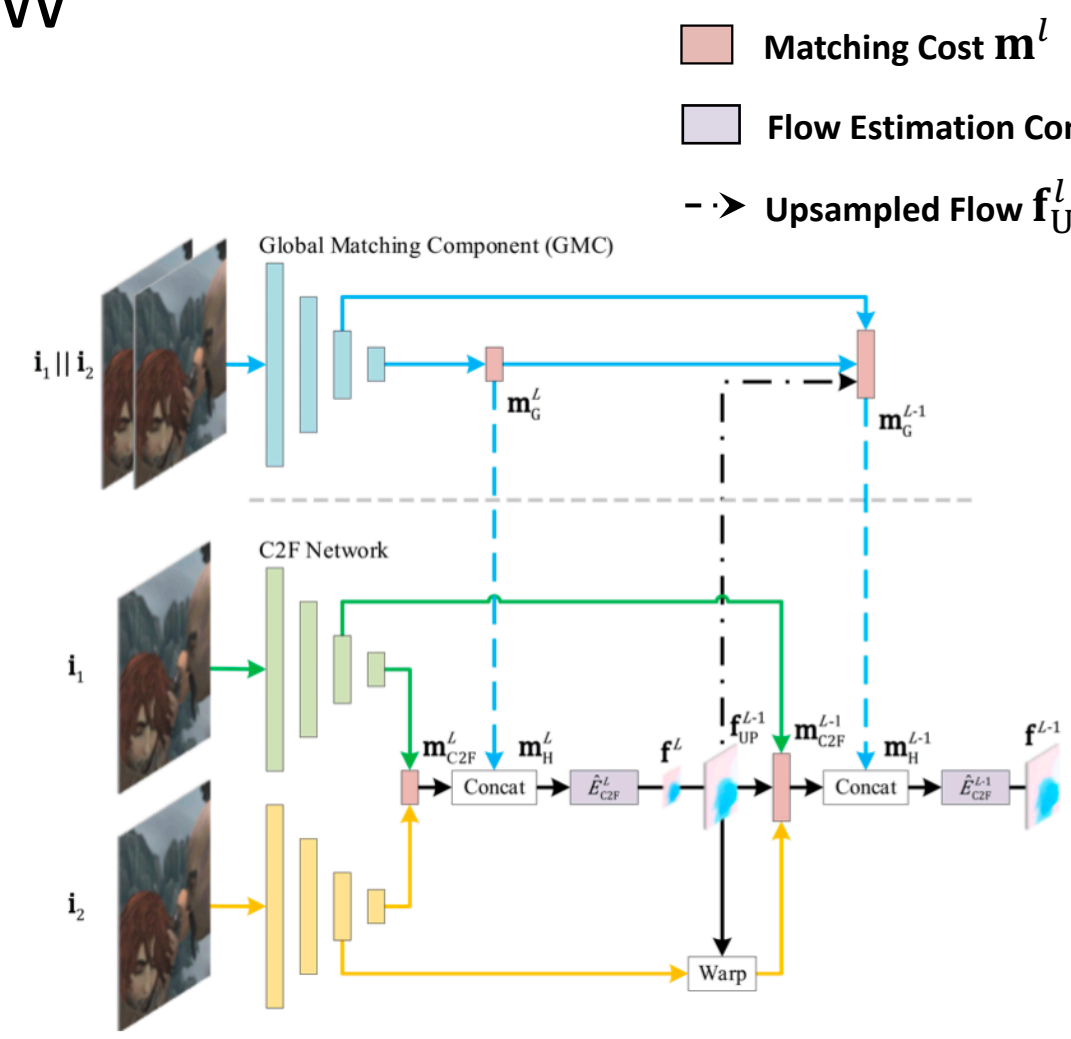
Global Matching Component

The theoretical receptive field of GMC expands by encoding, and further expands through skip-connection in decoding

The search range of GMC increases with resolution to whole images and keeps detail information at the same time

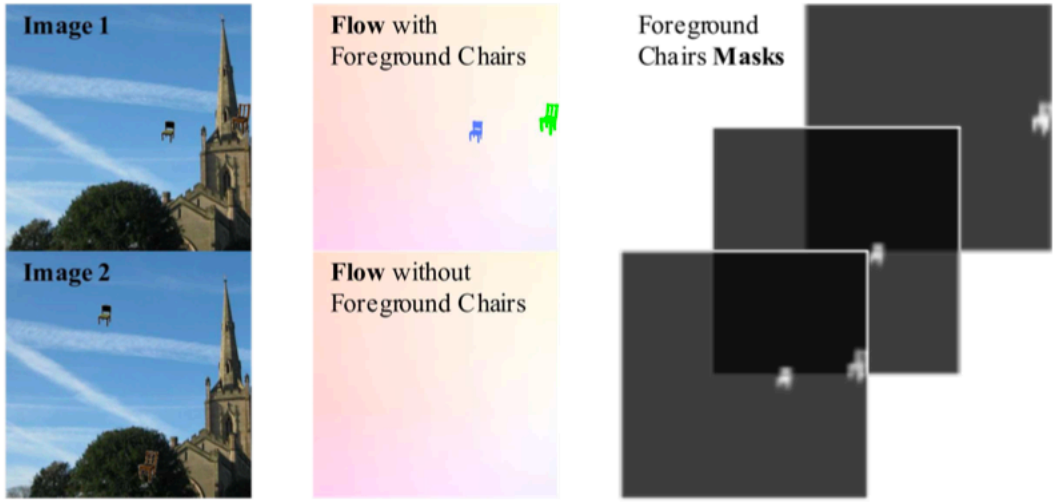
Coarse to Fine Network(C2F)

Integrates GMC to capture the small and fast-moving object



SFChairs Dataset

- ✓ 10000 Examples
  - ❑ 90% Training, 10% Testing
  - ❑ Including images, optical flow ground truth, and foreground masks for foreground chairs
  - ❑ All foreground objects are small and fast-moving objects
  - ❑ Target for flow estimation evaluation, especially for small and fast-moving object regions



Results

- AEE ON MPI Sintel

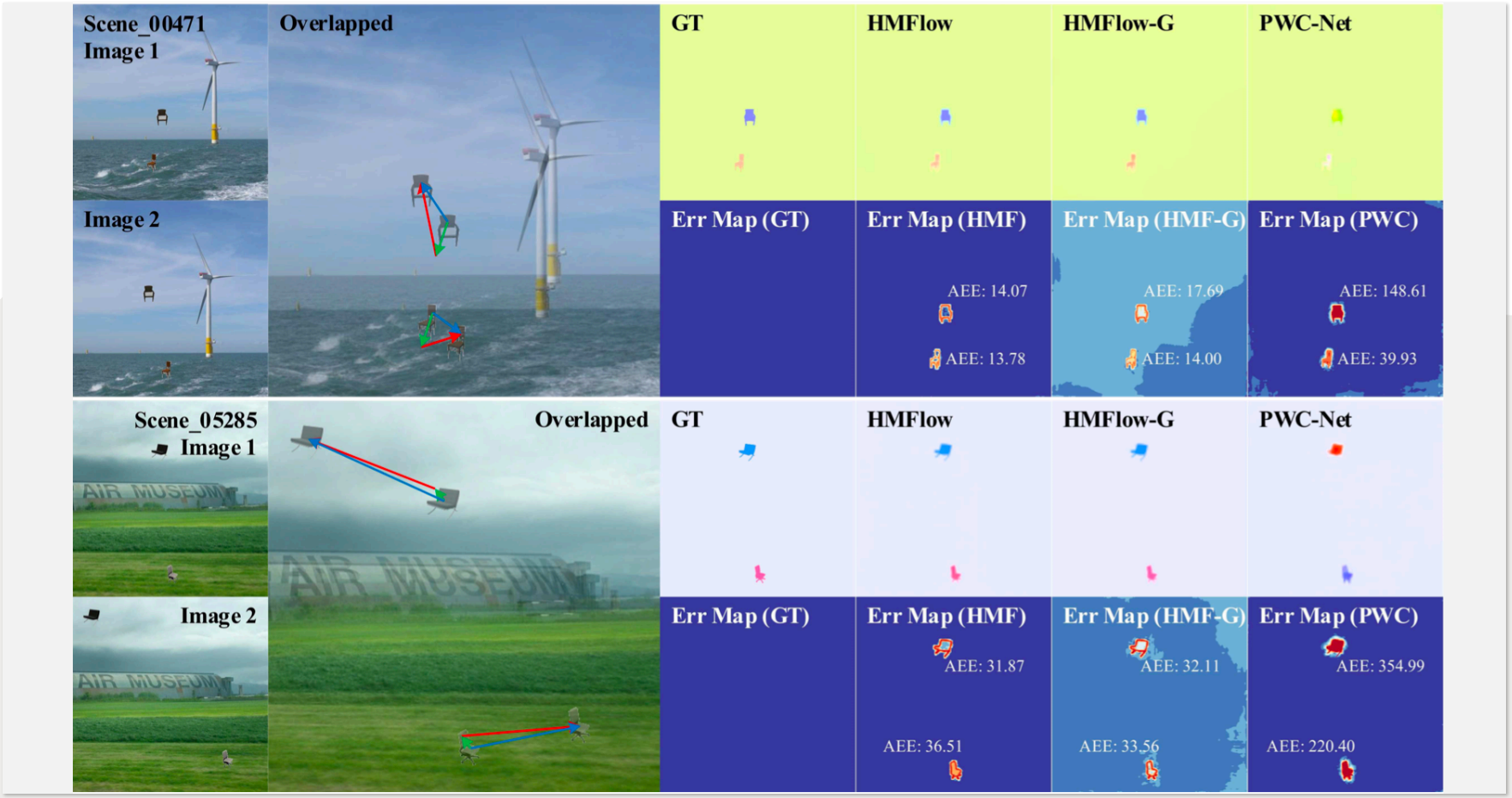
Methods	Training Set		Test Set		Size
	Clean	Final	Clean	Final	(million)
FlowNetS [11]	(3.66)	(4.44)	6.96	7.76	38.68
FlowNetC [11]	(3.78)	(5.28)	6.85	8.51	39.18
FlowNet2 [12]	(1.45)	(2.01)	4.16	5.74	162.52
SPyNet [13]	(3.17)	(4.32)	6.64	8.36	1.20
LiteFlowNet [14]	(**1.35**)	(**1.78**)	4.54	5.38	5.37
PWC-Net [15]	(1.70)	(2.21)	3.86	5.13	9.37
HMFlow	(1.44)	(2.23)	**3.21**	**5.04**	14.27

[a] The **Size** indicates networks' number of parameters in million.

- AEE ON SFChairs

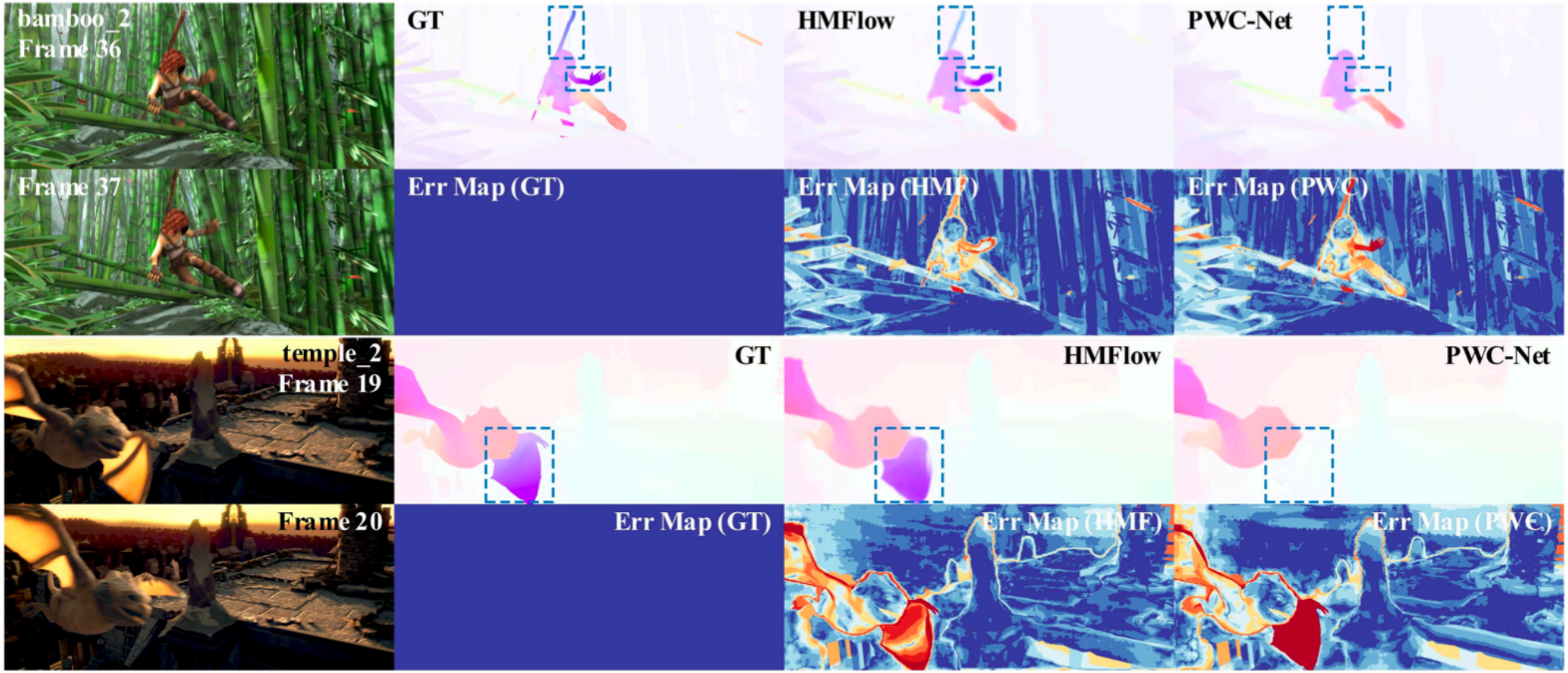
Models	Training Set			Test Set		
	All	Bg.	Obj.	All	Bg.	Obj.
PWC-Net	(0.62)	(0.27)	(64.54)	0.79	0.27	87.01
HMFlow-G	(0.59)	(0.36)	(45.58)	0.71	0.42	56.03
HMFlow	(**0.39**)	(**0.20**)	(**36.64**)	**0.45**	**0.21**	**44.34**

[a] The **All**, **Bg.** and **Obj.** indicate the AEEs of All image, Background and Foreground Object Regions.
[b] The **HMFlow-G** estimates flows with only GMC's global matching features.



Results

The Results and Error Maps on The Test Set of SFChairs



Results

The Results and Error Maps on The Training Set of MPI Sintel


Thanks