October 2012

# CURRICULUM VITAE

# AND LIST OF PUBLICATIONS

## Personal Details


Name: Yair Glasner

Place and date of birth: Jerusalem, September 22nd 1968

Work address and telephone:

Department of Mathematics
Ben Gurion University of the Negev,
Be'er Sheva, 84105, ISRAEL,
Department Phone 972-8-6461608/9
Office Phone: 972-8-6477877
Fax: 972-8-6477648
E-mail: yairgl@math.bgu.ac.il
Personal website: http://www.math.bgu.ac.il/~yairgl

Home address and telephone:

643 Har-Sneh,
Modi'in Israel
Home Phone: +972-8-9263357
Cell Phone: +972-54-7460335


## Education

B.Sc. - 1991-1994 – Hebrew University – Math Dept.

M.Sc. - 1994-1997 – Hebrew University – Math Dept.

*Name of advisor:* Prof. Shahar Mozes

*Title of thesis:* Covolume of lattices acting on products of trees.

Visiting student - 1997-1998 – Columbia University (NYC)

Ph.D. 1998-2002 – Hebrew University – Math Dept.

*Name of advisor:* Prof. Shahar Mozes

*Title of thesis:* Some remarks on lattices acting on products of trees.

## Employment History

| | | |
|---|---|---|
| 2009-Present | Senior Lecturer | Ben-Gurion University. |
| 2006-2009 | Lecturer | Ben-Gurion University. |
| 2005-2006 | Member | IAS (Princeton) |
| 2002-2005 | Research assistant professor | UIC Chicago. |

## Professional Activities

(a) Positions in academic administration
- 2006-2008 – Organizer of math dept. colloquium at Ben-Gurion.
- 2010-2012 – Head of the math department graduate student committee.
- 2011-2012 – Member of the math dept. hiring committee.

(b) Membership in professional/scientific societies
- 2005 – American mathematical society.
- 2006 - present – Israel mathematical union.

## Educational activities

(a) Research students
- Ofer Ben Mordehai – BGU - M.Sc. obtained 2009.
- Daniel Kitrosar – BGU - M.Sc. obtained 2009, now working towards Ph.D.
- Denis Gulko – BGU - M.Sc obtained 2010, now working towards Ph.D.

(b) Post docs supervised
- Zachary Mesyan - 2008-2010 – Currently assistant prof at University of Colorado, Colorado Springs.
- Amichai Nethaniel Eisenmann – Starting Fall 2012.

(c) Courses taught at American universities

Calculus I, Calculus III, Point set topology.

(d) Undergraduate courses taught at Israeli universities

Linear algebra I+II, Differential geometry, History of mathematics, Geometry, Calculus for electrical engineers, Ordinary differential equations, Partial differential equations for electrical engineers, Mathematical methods in error correcting codes, Expander graphs.

(e) Graduate level courses taught at Israeli universities

Linear groups, Riemannian geometry, Rigidity and group actions on CAT(0) spaces, Introduction to algebraic topology.

## Research grants

- 2007 – 2010 **Subgroups of random groups, arithmetic groups and expander graphs,** BSF research grant. Jointly with co-PI Prof. Miklos Abert from the University of Chicago.
- 2007 – 2010 **Topologies on discrete groups.** ISF personal research grant for 3 years.
- 2011 – 2015 **Invariant random subgroups.** ISF personal research grant for 4 years.

## Awards, Citations, Honors, Fellowships

(a) Honors, Citation Awards

- Ms.C. My thesis won the Giora Yishinski award 1996.
- B.Sc. Dean award for 1991,
- B.Sc. Rector award for 1994,

(b) Fellowships

- 2001 – Charles Clore foundation – This included a 3 year stipend but only one was used because I finished my Ph.D.
- "Amirim" fellowship – yearly scholarship for each year of study awarded by Hebrew University during my B.Sc.

## Scientifc Publications

(a) Published or accepted papers:

1. Benakli Nadia; Dasbach, Oliver T. Dasbach; Glasner Yair and Mangum Brian **A note on doubles of groups**. *J. Pure Appl. Algebra 156 (2001), no. 2-3, 147--151.*
2. Benakli Nadia and Glasner Yair **Automorphism groups of trees acting locally with affine permutations.** *Geom. Dedicata 89 (2002), 1--24.*
3. Glasner Yair **A two-dimensional version of the Goldschmidt-Sims conjecture.** *J. Algebra 269 (2003), no. 2, 381—401.*
4. Glasner Yair **Ramanujan graphs with small girth**. *Combinatorica 23 (2003), no. 3, 487--502.*
5. Glasner Yair and Mozes Shahar **Automata and square complexes**. *Geom. Dedicata 111 (2005), 43—64.*
6. Glasner Yair and Monod Nicolas **Amenable actions, free products and a fixed point property.** *Bull. Lond. Math. Soc. 39 (2007), no. 1, 138--150.*
7. Gelander Tsachik and Glasner Yair **Countable primitive groups**. *Geom. Funct. Anal. 17 (2008), no. 5, 1479--1523.*
8. Abert Miklos and Glasner Yair. **Generic groups acting on a regular tree.** *Trans. AMS, 361 (2009) no. 7, 3597—3610.*
9. Abert Miklos and Glasner Yair. **Most actions on regular trees are almost free.** *Groups Geom. Dyn. 3 (2009) no. 2, 199-213.*

10. Glasner Yair. **A zero-one law for random subgroups of some totally disconnected groups.** *Transform. Groups 14 (2009), no. 4, 787–800.*
11. Glasner Yair, Juan Souto and Pete Storm. **Finitely generated subgroups of lattices in.** *Proc. Amer. Math. Soc. 138 (2010), no. 8, 2667–2676.*
12. *Glasner Yair and Garion Shelly: **A highly transitive action of** arXiv:1208.2427. (to appear Groups Geometry and Dynamics).*
13. *Gelander, Tsachik and Glasner, Yair **An Aschbacher O'Nan Scott theorem for countable linear groups.** arXiv:1208.2427 (to appear J. Algebra.)*
14. Glasner Yair and Gulko Dennis. ***Sharply two transitive linear groups.*** *arXiv:1208.2427 (to appear IMRN).*

(b) Submitted for publication:

1. Glasner, Yair, **Strong approximation on random towers of graphs**, *arXiv:1208.2427 (submitted to Combinatorica).*
2. Abert, Miklos; Glasner, Yair and Virag Balint. **The measurable Kesten theorem.** *arXiv:1208.2427 (submitted to Annals of Probability).*
3. Abert Miklos; Glasner Yair and Virag Balint. ***Kesten's theorem for invariant random subgroups.*** *arXiv:1208.2427 (submitted to Duke math J.)*

(c) In preparation

1. Glasner Yair. **Invariant random subgroups in linear groups.**
2. Glasner Yair and Kitroser Daniel **Generic permutation representations and the LERF property.**
3. Glasner Yair. **Algebraic properties of generic invariant random subgroups of free groups – following Bowen and Hjorth.**

## Conferences organized

a. **Flato memorial conference**, Sde-Boker October 2008. Organized jointly with Daniel Alpay, Miriam Cohen, Daniel Sternheimer and Dito Giuseppe. http://monge.u-bourgogne.fr/gdito/mfmm/
b. **Lis Gains Workshop: Action of Aut(F_n) or representation varieties.** Sde-Boker January 6th -11th 2009. Organized jointly with Tsachik Gelander. http://www.math.bgu.ac.il/~yairgl/Conferences/AutFn/Sde_Boker.html
c. **Geometry of group actions on CAT(0) spaces and buildings,** Sde-Boker January 31st - February 6th 2010. Organized jointly with Tsachik Gelander and Talia Férnos. http://math.huji.ac.il/~fernos/CAT%280%29
d. **Property (T) and around,** Sde-Boker; Ferruary 6th - 11th 2011. Organized jointly with Uri Bader and Tsachik Gelander. http://www.math.bgu.ac.il/~yairgl/Conferences/Around_T/Around_T.html
e. **Avner Magen memorial lecture day.** Organized jointly with Eitan Bachmat. Ben-Gurion July 7th 2011. http://www.math.bgu.ac.il/~yairgl/Conferences/Avner/

f. **Invariant random subgroups**, Sde-Boker February 26th – March 2nd 2012. Organized jointly with Tsachik Gelander. http://www.math.bgu.ac.il/~yairgl/Conferences/IRS/IRS.html
g. **Dynamics and Ergodic theory session of the 2012 IMU meeting**. http://imu.org.il/Meetings/IMUmeeting2012/index.html

## Lectures, Presentations at Meetings and Invited Seminars

(a) Invited plenary lectures at conferences/meetings

- **Geometric methods in permutation representations of groups.** The 15th Amitsur Memorial Symposium, Hebrew University, Jerusalem, July 1-2, 2009.

(b) Presentation of papers at conferences/meetings

- 2012 - **Non-free actions of linear groups, on sets and on probability spaces.** Action now seminar – Belin October 2012.
- 2012 – **Random invariant subgroups of linear groups.** Sde-Boker February-March 2012.
- 2011 – **Of highly transitive actions of Out(F_n).** Ergodic decompositions of representation varieties, Princeton, October 2011.
- 2011 – **Counting circles in regular graphs and the measurable Kesten theorem.** Groups graphs and Stochastic processes. BIRS. June 2011.
- 2010 – **Random invariant subgroups of linear groups.** Action Now meeting, Wiezmann Institute December 3rd 2010.
- 2010 - **Ramanujan graphs have few circles**. Workshop on Geometric Group Theory, Goa, India, August 9-14, 2010,
- 2010 **On the geometry of affine Bruhat Tits buildings.** Workshop on CAT(0) spaces and affine buildings, Sde Boker January 30- February 6, 2010.
- 2009 - **Ergodicity of Aut(F_n) actions on representations of the free group in** *Sde-Boker Israel,* Dynamics of actions on representation varieties.
- 2008 – I gave a series of two talks:
    - **Ergodicity of Aut(F_n) actions on representations of the free group in**
    - **Finite automata and the commensurator of a regular tree.**

  *BIRS research center – Banff Canda,* Conference on Self-Similarity and Branching in group theory (Oct. 2008)
- 2008 – **On the number of infinite index maximal subgroups.** *Ashkelon, Israel,* Annual IMU meeting (May 2008)
- 2007 – **An Aschbacher-O'Nan-Scott theorem for Linear groups,** *MFO Oberwolfach Germany,* Permutation groups (Aug, 2007).
- 2007 – **Strong approximation in random towers of graphs,** *Be'er Sheva, Israel,* Annual IMU meeting (May 2007)

- 2006 – **Amenable actions of non-Amenable groups** - *AIM Research Conference Center, Palo Alto, California*. Worksop: Dichotomy Amenable/Nonamenable in Combinatorial Group Theory (Jun/Jul. 2006)
- 2006 – **Strong approximation in random towers of groups.** *Ein Gedi, Israel,* Group theory: geometric and probabilistic methods (Oct. 2006)
- 2005 – **Finitely generated vs' normal subgroup in 3-maifold groups,** *BIRS research center – BIRS, Banff Canada* Geometric and Asymptotic methods in group theory, (June 2005).
- *2004* - **Ramanujan graphs and their girth**, *Institute for pure and applied Mathematics, UCLA*. Automorphic Forms, Group theory and Graph Expansion (Feb. 2004).
- 2004 - **Primitive groups, in various geometric settings**, *Candian math. Soc. Winter meeting 2004, Montreal, Quebec. (Dec 2004).*
- 2004 - **Randomly generated subgroups of** *MFO Oberwolfach*, *Germany.* Meeting on Buildings and Curvature. (May 2004).
- 2003 - **New Geometric methods in groups generated by finite automata**. *Gaeta Italy* International conf. on group theory (June 2003).
- 1999 - **A two dimensional version of the Goldschmidt-Sims conjecture**. *Anogia, Crete* Groups of tree automorphisms and lattices (July 1999).

## Synopsis of research

I summarize here in a few paragraphs my main recent research directions. In each paragraph I quote my relevant papers in square brackets, corresponding to the above list in the section "Scientific publications". The distinction between the different topics is sometimes superficial and hence some of the papers appear more than once.

*Invariant random subgroups.* By definition an invariant random subgroup (or IRS for short) in a locally compact group G is a random closed subgroup whose distribution is invariant under conjugation by G. This notion generalizes the notion of a normal subgroup $N \lhd G$ (which can be thought of as an invariant delta measure) and at the same time the notion of a lattice $\Gamma < G$ (where the random subgroup is a Haar-random conjugate of the lattice). It turns out that many important properties of normal subgroups and of lattices can be generalized to the more general setting of IRS. This is indeed useful because the notion of an IRS is more amenable to general operations such as taking limits (w* limits of measures on the space M(Sub(G)) of probability measures on the subgroups of G) and inducing (from a lattice to the ambient group). The first, and one of the deepest results to date, about IRS is the classical result of Stuck-Zimmer; which can be interpreted as a full classification of ergodic IRS in simple, higher rank, Lie groups and in their lattices.

The term IRS was coined in a recent joint paper with Abert and Virag [b2] which generalizes the classical spectral radius theorem of Kesten to IRS in finitely generated free groups. This "measurable Kesten theorem", together with the flexibility that IRS theory enables in passing to limits gives rise to a "probabilistic high girth" statement: if the spectral radius of a sequence of finite d-regular Xn converges to that of the tree then the injectivity radius around a uniform random vertex of Xn converges to infinity. This answers a question of Lubotzky on the connection between girth and the Ramanujan property in graphs, and also enables us to considerably strengthen a classical theorem of Serre and McKey on the asymptotic number of circles in d-regular graphs. In a sequel paper [b3] the measurable Kesten theorem is generalized to general finitely generated groups. In a paper [c1] that is now being written I initiate a more systematic study of the theory of IRS in the more structured setting of countable linear groups. I prove a Tits alternative type of theorem saying that if $H<G$ is an ergodic IRS in a countable linear group G then either H is contained in the amenable radical of G or there is a free subgroup $F<G$ such that FH=G and $F\cap G$ is non-Abelian almost surely.

The notion of study of IRS became very active in the past few years. I mention just a few major results. Bowen defined the Poisson boundary of an IRS and used it to solve the realization problem of Furstenberg entropy in free groups. Vershik gave a classification of IRS in the countable infinite symmetric group. Abert-Avni-Wilson proved an IRS simplicity result, showing that the groups GL(n,F) do not admit any IRS when F is a countable field. Abert-Bergeron-Biringer-Gelander-Nikolov-Raimbault-Samet applied IRS methods (similar to those we used for graphs) to the study of locally symmetric spaces and gave fantastic estimates on the asymptotic of Betti numbers and representation coefficients.

*Infinite permutation representations.* I am interested in the study of a countable group G via its permutation representations. This study is directly related to the study of the subgroups of G via the bijection between conjugacy classes of subgroups and transitive permutation representations.

Every group can be realized as a permutation group, but restrictions start apply upon imposing various transitivity restrictions on the permutation action. An action is *quasiprimitive* if every normal subgroup acts either trivially or transitively, it is *primitive* if there is no non-trivial invariant equivalence relation on the set, it is *k-transitive* if the induced action on ordered k-tuples is transitive and *highly transitive* if it is k-transitive for every k. We say that a group is *primitive* if it admits a faithful primitive permutation representation and similarly for all the other properties mentioned above. Together with Tsachik Gelander in [a7,a13] we give a rather complete classification of primitive groups in various well understood classes of countable groups: linear groups, convergence groups, groups acting on trees and subgroups of mapping class groups of surfaces. The methods used stem from, and generalize, the methods of Margulis-Soifer who previously classified finitely generated linear groups admitting infinite index maximal subgroups. One important feature of our work is that, unlike Margulis-Soifer we treat countable groups rather than finitely generated ones – hence we significantly generalize the discussion even in the setting of their original question on the existence of infinite index maximal subgroups. Influenced by these ideas, in a recent joint paper with my student Dennis Gulko [a14] we classify all linear (in characteristic $\neq 2$) sharply 2-transitive groups. Namely every such group is of the form $N^* \ltimes N$, where N is a near field. This proves in this specific setting the standing conjecture in the field, thereby generalizing classical known results for finite groups.

It is a question of much interest to me which groups admit are highly transitive. It is shown by Dickson that free groups are highly transitive. Daniel Kitroser, a student of mine, in his masters dissertation generalized this to surface groups. I strongly believe, but have not been able to show this so far that higher rank lattices do not admit such actions. If true this would be a type of a rigidity result with S(∞) target. Nevertheless, in a joint paper with Shelly Garion [a12] we show that the group Out(F_n) is highly transitive for any n≥4. Since Out(F_n) is often compared to a lattice I found this result quite surprising. It is interesting to understand the situation for mapping class groups.

In [a6] jointly with Nicolas Monod we study the question of which groups admit a faithful transitive amenable permutation representation. Where a permutation representation is amenable if the set carries a G-invariant mean. This is an old question asked by von-Neumann. We give a complete classification of free products of countable groups that admit such actions. These results and methods were latter generalized and extended by Moon.

One additional question I have been considering in this context is that of generic permutation representations of countable groups. Indeed the set of all permutation representations of a group G on a countable set admits a Polish structure and it makes sense to ask about the properties of a typical action in the Bair category sense of the word. Jointly with my student Daniel Kitroser in [c2] we show that a typical such action admits only finite orbits if and only if the group G has the LERF property, (i.e. If and only if all of its finitely generated subgroups are profinitely closed). We extend this line of ideas and study groups whose typical permutation representations admit amenable orbits.

*Out(F_n) actions.* Consider the action of the groupon the "representation variety" . The nature of this object depends on that of the group G. When G is an algebraic group this is really a variety (or an algebraic stack), when G is finite this is just a finite set and if G is compact (resp. Locally compact and unimodular) this space admits an invariant probability (resp. ***σ-finite)*** measure, coming from Haar measure. Much effort has been invested in the study of the dynamical properties of this action. For example a conjecture of Goldman that was later proved by Gelander is that this action is ergodic whenever G is a compact Lie group. In my paper [a10] I treat a similar question where G=SL(2,k) and k is a local field. The action in this case is not expected to be ergodic, because the set of homomorphisms whose image is discrete, or compact are invariant subsets of non-zero measure. Allowing for that however I show that the action of G on the invariant set of all homomorphisms with dense image is ergodic whenever the field k is non-archmedian. This combines beautifully with a recent result of Yair Minsky who shows that when k is non-archemedian then the action is not ergodic. Currently I am working on generalizing this results to other simple algebraic groups.

Let me mention here that the highly transitive actions constructed in [a12] are also actions on "representation varieties" of a very esoteric nature. In order to achieve such transitivity we use a Tarski monster (discrete) group for G.

*Burger Mozes theory of lattices in products of trees,* invented by Marc Burger and Shahar Mozes (my thesis advisor) and Bob Zimmer. The significant impact of this theory on infinite group theory during the last decade is due its success in constructing examples of groups that exhibit properties reminiscent of arithmetic groups in non-arithmetic settings. Arithmetic groups, such as the group of unimodular integral matrices, form the backbone of modern infinite group theory - they encode in them all of the richness and the complexity of the integer numbers.

The Burger Mozes theory was the main focus of my research during my M.Sc and Ph.D studies and I have published a few papers on the subject [a1,a2,a3,a4,a5]. Since then the main direction of my research has shifted but I am still deeply influenced by the main motivation of Burger Mozes theory – looking for analogues of deep arithmetic phenomena in other combinatorial, probabilistic and geometric settings. A good example of this influence is my recent paper [b1] (submitted to Combinatorica). There in the setting of probabilistic group theory I exhibit phenomena reminiscent of *strong approximation theory* in arithmetic groups.